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THE OUTLOOK IN THE SCIENCE OF NUTRITION[1]

By Dr. LAFAYETTE B. MENDEL

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THERE can be little doubt, I think, that the world war exerted a profound influence upon the status of science. The stress of that period developed among all the civilized nations a realization of the enormous part that the contributions of science really played in the pressing affairs of the day. Only a few years earlier one might have been content to say, with Michael Pupin: "Science in its abstract side is poetry; it is Divine Philosophy, as Milton calls it." "Science," he added, "is the food which feeds not only the material but also the spiritual body of man." Then, quite suddenly, in times of national need, there was awakened a conviction that everything is possible to science; and it was promptly called upon to solve some of the most perplexing practical problems that had ever confronted the world.

In 1919 the late Professor W. D. Halliburton stressed the usefulness of physiologists during the war.

It has been a war [he wrote] in which science has played a leading rôle. It has been so for mechanicians of every sort, on the land, on the sea and in the air. It has been so for the chemists who devised new explosives and new methods of attack, for instance, the poison gases. Many other examples of the chemical side of warfare might be adduced, but let us see what physiologists and physiological chemists have done. They stepped in not to add to the horrors of the battlefield, but to alleviate distress, and the very agent, chlorine, used for destructive purposes became in their hands the basis of the new antiseptics which have done so much to cure the wounds of war.[2]

The science of nutrition, in particular, was subjected to the influences of that turbulent period. The familiar wartime slogan, "Food will win the war," became the expression of research aspirations as well as practical endeavors. Permit me to quote some of the vigorous propaganda of the day.

[1] A paper presented at the meeting of the Federation of Biological Societies, Cincinnati, April, 1933.

[2] W. D. Halliburton, "Physiology and National Needs." E. P. Dutton and Company, New York, 1919.

Patriotism and food! Winning a world war by eating corn and chicken instead of wheat and beef! It will take much education to get this point of view. An army of food-savers does not appeal to the imagination at first consideration. But remember the large words of M. Bloch: "That is the future of war—not fighting but famine." . . . It is a time of rare and glorious opportunity; a time in which prosaic business and industry may be lifted up to the high plane of national service. And it is being so conceived in many quarters. . . . It is not a sordid association, patriotism and food. It can be as fine as the spirit of democracy and as ennobling as the struggle for democracy. For it is, in truth, in these days an essential part of each.

These are the words of Vernon Kellogg and Alonzo Taylor.[3]

The older members of the Federation will readily recall the general public indifference to the discoveries in the science of nutrition at the beginning of the century. When the need for food control became acute as a war-time measure there was, as Halliburton[4] has recorded for Great Britain, "a tendency to pooh-pooh the scientific aspect of the question: these were the days when mistakes occurred, for example, the use of rhubarb leaves. Things did not run smoothly until the Ministry made the remarkable discovery that people who have made a lifelong study of a subject are those who really know something about it, and are the only people in the position to give trustworthy advice." Referring to one of the meetings of the Interallied Food Commission at Rome, Halliburton[5] remarked:

My friend, Professor Chittenden, the apostle of moderation in food in the United States, and one of the representatives of that country at the Interallied Conference, put it very happily when he said, "In the ancient days the edict went forth from Rome that all the world should be taxed; to-day it is from Rome that the world will hear how it is to be fed." But the work of such conferences has not been final: one thing became very clear as time went on, and that is, the imperfection of our present knowledge, and therefore the machinery has been set in action for the future; various topics about which at present we know very little still are to be investigated.

It was inevitable that, amid an environment in which practical needs daily obtruded, attention should be directed to the energy aspects of nutrition. The word "calorie," in reference to food fuel, attained a long-deserved popularity. Our lamented colleague, Graham Lusk,[6] wrote in 1914:

The workshops of life require fuel to maintain them, and a necessary function of nutrition is to furnish fuel to the organism that the motions of life continue. Furthermore, the workshops of life are in a constant state of partial breaking down and materials must be furnished to repair the worn-out parts. In the fuel factor and the repair factor lie the essence of the science of nutrition.

In harmony with such views the study of animal and clinical calorimetry flourished. The investigation of basal metabolism and of related domains was prosecuted with outstanding success.

Thus there are times, as we have already noted, when special conditions tend to motivate the efforts of physiologists so that they are directed into certain experimental channels. There are also periods in the history of most branches of scientific endeavor when the conventional methods of study in certain fields seem to reach the limit of their profitable applicability. Progress becomes slowed; and investigators tend to abandon what seem to be sterile fields. This appears to have been true of that branch of the science of nutrition which I shall designate as alimentation. The expression is intended to include the sum total of the several processes that occur in the different regions of the digestive tract. Here ingested food materials are subjected to the varied environments furnished by the alimentary secretions—the saliva, gastric, pancreatic and intestinal juices and bile. In the contents of the gastro-intestinal canal a diversity of enzymes promotes a succession of chemical changes of outstanding importance for the nutritive functions of the body. The so-called "building stones" for the rest of the organism are liberated. Microbiotic changes also enter into the picture. At the same time absorptive processes take place, to a variable extent, in the different regions of the bowel.

Some of us can recall the days when these highly important functions—secretion, digestion, absorption, to which may be added the alimentary movements—were among the dominant topics of physiological and biochemical investigation. In recent years, however, this research interest has waned. Shall we conclude that the details of the fate of our foods in alimentation have been fully discovered and that the physiological problems presented thereby are adequately solved? Professor Abderhalden, of Halle, once wrote: "The cells of our body never know the food that we eat." This statement was a protest against the older assumptions that our foodstuffs are only slightly changed—perhaps only rendered more soluble and diffusible—prior to their absorption and transport from the digestive tract to the other tissues. Presently newer theories of alimentary function were propounded, in which simple sugars, amino acids, fatty acids, glycerol, sterols, inorganic ions, and the

[3] V. Kellogg and A. E. Taylor, "The Food Problem." Macmillan Company, New York, 1917.
[4] *Op. cit.*
[5] *Op. cit.*
[6] G. Lusk, "The Fundamental Basis of Nutrition." Yale University Press, New Haven, 1914.

as yet unidentified vitamins, became the true nutrients in the minds of physiologists.

The current teachings are familiar to all of you. Are we satisfied that they tell the correct story in its entirety? Let us select a few items for the purpose of illustrative discussion. Consider first, if you will, the fate of ingested fats and related substances. A prominent text-book writer[7] of my own student days summarized the knowledge of 1891 as follows:

> Since fat is the only alimentary substance that can be detected after its absorption from the contents of the intestine, attention has been chiefly directed towards the investigation of the path taken by the absorbed fat-particles, but it is highly probable that the amoeboid cells are actively concerned in promoting the absorption of alimentary substances of all kinds. . . . Many observations have been accumulating recently, which show the importance of the part played by leucocytes in the promotion of various absorption processes.

Obviously such an indefinite explanation could at best serve only to stimulate further investigation. The assumption that fats are absorbed, presumably with only slight chemical change, in the form of a fine emulsion was presently attacked by Pflüger. He championed the digestive hydrolysis of fats whereby they are absorbed in the form of water-soluble compounds—soaps and glycerol. This hypothesis was later supplemented by the claim that certain bile constituents favor the solution and absorption of free fatty acids. The demonstrated occurrence of neutral fats in large amounts in the lacteals necessitated the postulation of a resynthesis of fats within the absorbing cells.

The digestive aspects of this explanation are in complete accord with the current assumptions about the changes undergone in alimentation by proteins and carbohydrates. In a review of our knowledge of the absorption of fats in one of the newest issues of *Nutrition Abstracts and Reviews*, Verzär[8] presents some of the difficulties entailed by the conventional teachings. I venture to quote a few:

> The work of Henriques and Hansen has long been quoted as convincing evidence in support of Pflüger's theory. They found that when emulsions of fat and paraffin were fed to animals it was only the fat that was absorbed. This result is obviously not so conclusive as at one time believed. . . .
>
> Recent investigations of the reaction of the intestinal contents have cast considerable doubt as to the veracity of the contention that the fatty acids, as soon as they are liberated, combine with the alkali present there to form soaps. It has indeed been shown that an alkaline reaction is rarely, if ever, found in the small intestine, but that the contents are generally frankly acid in the higher levels, and less so in the lower levels. Even in the ileum the pH rarely rises above neutrality. . . .
>
> We have no basis for the assumption that lecithin is a factor in the absorption of fats, nor do we consider this assumption necessary. The question why less bile acid is required for fat absorption in the intestine than is necessary *in vitro* still remains to be answered. One can only come to the conclusion that the bile acids must act locally upon the permeability of the mucous membrane. Therefore we have suggested the hypothesis that it is unnecessary for the bile acids to dissolve all the fatty acid at the same time, but that the former are adsorbed on the surface of the epithelial cells of the intestinal mucous membrane, and in that position can repeatedly conduct new quantities of fatty acids in water-soluble form through the surface of the epithelium. This seems probable, because of the well-known fact that the fat present in the interior of the epithelial cell is neutral fat; so that the choleic acid complex must have been split there. The bile acid when set free could, as a strongly surface-active substance, easily be adsorbed on the cell surface, especially on to the outer finely striated border of the cells. There it could repeatedly dissolve fatty acids and transport them through the membrane. Conclusive evidence of the accuracy of the above view is very difficult to obtain.

Verzär points out that the alleged effect of bile acids in absorption is concerned not only with the fatty acids but also with a principle of much more general significance.

> These extraordinarily active hydrotropic substances are constantly secreted by the liver. They influence not only the absorption of fats, but also that of many other substances, exerting their effect directly on the substances and partly on the surface of the mucous membrane.

Again we are reminded that

> The subsequent fate of the fat is almost a complete mystery. Neutral fat is found in the lymph stream, but how it gets there from the interior of the epithelial cells or into the fat depots from the blood stream, and back again when it is being mobilized, is almost entirely unknown. It may be that besides bile acids other hydrotropically active substances are formed in the body with the aid of which water-insoluble substances can be taken up into the cells. If such is the case, it is probable that these (hypothetical) substances are called into activity during the laying down of fat in the depots and also when there is a demand for fat from other regions of the body. It is well known that during starvation as well as during fat absorption, the blood is laden with fat, and it is obvious that this lipemia can only be brought about in the starving animal by the transference of fat from the depots into the blood stream. It is indeed probable that the lipoids of the cell membrane

[7] W. D. Halliburton, "A Text-book of Chemical Physiology and Pathology." Longmans, Green and Company, London, 1891.

[8] F. Verzär, "The Absorption of Fats." *Nutrition Abstracts and Reviews*, 2: 441, 1933.

play some part in the passage of fat across cell boundaries.

It has recently been claimed by Tangl and Berend that the fatty acids set free in the intestine by lipase are then converted into unsaturated and water-soluble fatty acids, in which form they can readily pass into the epithelium without the aid of the bile salts. The existence of such unsaturated acids in the fat depots of the organism had been previously pointed out. Analyses of intestinal contents that have been made in regard to this point suggest that these unsaturated acids are formed in such small amounts that they can not be considered to play any rôle other than a very subordinate one in fat absorption.

It must be frankly admitted that no adequate "balance sheet" has ever been submitted for the disposal of digested and absorbed fat. Part of the fat found in the feces is asserted to be of intestinal origin. Much of the fats absorbed can be recovered in the thoracic lymph; but what becomes of the missing fraction? Have our experimental procedures proved to be inadequate?

In connection with the behavior of fats reference may appropriately be made to the possible indispensability of certain types of fatty acid for adequate nutrition. Until quite recently the dietary fats were regarded to be useful merely as fuel for the expenditure of energy. Studies reported during the past six years, notably by Burr and by Evans working with diets rendered rigidly fat-free, raise the question as to the need of small amounts of unsaturated fatty acids such as lineoleic acid to avert nutritive disaster. This discovery, if confirmed, would place such fat components in a class with the known indispensable amino acids, notably cystine, lysine, histidine and tryptophane. Hitherto unsuspected but highly important physiological distinctions may exist between different ingredients of the numerous dietary fats and the little considered fatty components of other foods. The implications of the specific rôles of highly unsaturated fatty acids in the body are manifold. Such substances present abundant opportunities for the investigation of their intermediary behavior in the body.

Far from having a satisfactory story of the fate of fat, a foodstuff that commonly constitutes about one third of our daily food fuel intake, we must frankly admit a record of incompleteness, if not actual confusion. There are added problems of enzymatic (lipase) functions, the influence of the alimentary reactions, the possible rôle of bile constituents, and of vitamin factors. Histology and biochemistry have not yet furnished concordant and conclusive evidences about the behavior of fats. The entire record presents an illustration of what Sir Michael Foster, speaking of an analogous situation in regard to the intermediary metabolism of proteins, once termed "a chapter of gaps and guesses."

The most optimistic conclusion that Verzär has marshaled intimates that

> We are justified in saying that the mechanism of absorption of fat is now understood, at least to some extent. The process is a complicated one, and depends on the reaction of the intestinal contents, on the formation of hydrotropic substances and on the action of these in bringing the insoluble fatty acids into solution and in altering the permeability of the epithelial cells. On the other hand, the precise way in which the fat is transferred from the intestinal mucosa into the depots and from there to other tissues in accordance with metabolic requirements is almost unknown.

Surely this is a vigorous challenge to renewed research.

A somewhat similar, though perhaps less confused situation prevails with respect to the nitrogenous foods. We prefer at present to believe that proteins are completely disintegrated into amino acids prior to the absorption of the nutrient components. This is a postulate of the current theories of nutrition. It obviously represents a profound change from the earlier inadequate views of protein digestion; but is it entirely tenable? Are we justified in concluding dogmatically that none of the ingested protein is absorbed in the form of polypeptide fragments? I recall that only a few years ago Abel raised the question as to whether or not proteoses penetrate the gastrointestinal barrier to some extent. Prolonged nutrition and growth have not yet been secured on rations in which amino acids alone supply the nitrogenous food. The splendid experiments of W. C. Rose represent the nearest approach to success. However, even success with such a dietary regimen is not proof that in ordinary nutrition polypeptides are not absorbed and that they do not participate in metabolism.

With respect to the nucleoproteins also, the student of to-day is taught the theory of complete alimentary disintegration of these compounds to the stage of purines, pyrimidines and the other end products of enzymatic hydrolysis. Nevertheless, the possibility of the absorption of intermediate nucleosides and nucleotides is by no means conclusively excluded. Indeed, these may represent in no small measure the physiologically preferred form in which purine compounds are distributed in metabolism.

Several writers have recently pointed out that the time is now at hand to appraise more clearly the relation of the "minerals" in the diet to such factors as vitamins, internal secretions and especially to intermediary metabolism. If this is true, one of the important steps is to learn more about the manner

and the form in which the important inorganic elements are made available in the alimentary canal during the customary dietary régimes. Despite the enormous amount of study that has been devoted to the most prominent inorganic elements, calcium and phosphorus, the details of their ingress and egress are far from satisfactorily explained. The possible rôles of the so-called "trace" elements continue to present an engaging opportunity for research. The newer findings regarding the behavior of magnesium, the claims regarding manganese, the action of copper and the revelations of mottled enamel in human teeth afford illustrations of some of the popular research trends in the laboratories of to-day.

In the past the study of alimentation in relation to nutrition has been concerned primarily, if not almost exclusively, with the familiar predominant "proximate principles." In every-day life, however, diet consists of something more than simple mixtures of the commonly recognized foodstuffs, such as milk conspicuously represents. Vegetable products in the form of leaves, roots, tubers, buds and fruits enter abundantly into the rations of man and of animals. Unique nutrient advantages are being ascribed to these foods; while our knowledge of what actually happens to them chemically in the long reaches of the alimentary tract is woefully limited. The investigation of the "roughage" problem, for instance, is still being prosecuted, if not greatly promoted, by the questionnaire method of study.

The discovery of the remarkable relationship between carotene and vitamin A may serve to remind us of our ignorance regarding the possible biological value of a number of pigmentary substances, not excluding the ubiquitous chlorophyll. The student of nutrition has frankly neglected them. Now that the biochemist is developing new methods of approach we may perhaps look forward to interesting new contributions.

The dietary function of the organic acids of vegetables is almost entirely unknown. Man and animals must ingest considerable quantities of compounds like citric, malic, tartaric and oxalic acids. How do they function in alimentation? Do they find their way into the systemic circulation or are they disposed of in the liver? Again, the edible glandular foods, such as liver, kidney and thymus, were formerly thought of, aside from their protein content, primarily as potential sources of uric acid-forming purines. Now they are regarded as sources of other dietary factors including hemopoietic agents; thus they present additional complex problems for the physiological chemist engaged in the study of digestion and intermediary metabolism.

In order to convince myself that my thesis regarding the present-day indifference to some of the unsolved problems of digestion is not utterly untenable I have examined some of the representative sources of information. The indexes of *Physiological Reviews,* which now cover more than a decade, fail to reveal any comprehensive essay devoted primarily to the debated chemical aspects of alimentary digestion. These years have, of course, witnessed a renewed interest in the biochemistry of enzymes. The work of Willstätter, Waldschmidt-Leitz, Northrup, Sumner, Sherman and many others has brought outstanding new contributions to our knowledge of the isolation, structure, specificity and dynamics of the organic catalysts. But the direct application of these contributions to the alimenary functions has rarely been attempted. Alimentary digestion, *per se,* is not discussed in the "Annual Review of Biochemistry"; and it is referred to only sporadically in the recent very comprehensive volume on "Nutrition" issued by the White House Conference on Child Welfare and Development. These omissions are, in my opinion, an indication of the difficulty experienced by reviewers in presenting new or novel information about alimentation. There is need of additional facts secured through new methods of attack upon the problems involved.

It is fortunate that attention is being directed anew to the absorbing force of the intestine in studies such as those of Drinker, H. S. Wells and their coworkers. Their investigations involve, among other features, the relative participation of the lymph and blood systems. The provision for the transport of the digestion products is a physiological feature of nutrition in its broadest aspects. It deserves further scientific consideration destined to eliminate the hazy hypotheses of indefinable "vital" forces. When we attempt to peer beyond the alimentary barrier into the blood stream the newer conceptions of the relation of the circulating proteins to nutritional edema present novel features of practical medical importance as well as of purely scientific interest. The existence of "war dropsy" and of endemic edema of nutritional origin in this country calls for serious consideration; the investigation of plasma proteins has aroused new enthusiasms.

If in these hurried and admittedly superficial comments I have appeared to overlook or disregard some of the obviously pressing problems of research in nutrition, it is not because of indifference to their importance. No one could have followed closely the progress of vitamin research during the past two decades without appreciating the imperative need of a chemical identification of the vitamins, and a clear explanation of their individual physiological rôles. This audience needs no such reminders, nor is it unaware of the pressing and complex problems of the

intermediary metabolism of the foodstuffs, their interconvertibility and the chemical reactions concerned in the exchange of energy. Soon the question whether alcohol is a food will be heard again. I have ventured rather to direct attention to less popular and partly neglected opportunities for intensive study.

Sir William Osler, describing a special part of medical literature, once remarked: "What a desolate sea of theory and speculation!" Most of us are familiar with such areas in our own domains of science. They call for initiative and forethought to explore and chart them more satisfactorily.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE SEVENTEENTH ANNUAL MEETING OF THE PACIFIC DIVISION

By Dr. J. MURRAY LUCK

SECRETARY, STANFORD UNIVERSITY

THE seventeenth annual meeting of the Pacific Division of the American Association for the Advancement of Science, together with its associated societies, was held from June 12 to 15 in Salt Lake City, Utah, eleven years having elapsed since the association last met in this region. Generous hospitality was provided by the University of Utah.

Two hundred eighty-seven members and guests registered for the meeting and twelve of the associated societies participated. Though ranking as one of the smaller meetings of the Division, the sessions were of singular interest by virtue of the large proportion of excellent papers and the lively discussions which followed.

The sessions commenced on the afternoon of June 12 with reviews of the scientific contributions of the past year in four fields of science. Dr. H. H. Kimball, president of the American Meteorological Society, presented the report on recent advances in meteorological research. Studies of the Bjerknes polar front theory of the development of cyclonic storms and investigations on the vertical temperature distribution in the atmosphere were reviewed in some detail. The researches at Point Barrow, Alaska, proceeding under the program of the International Polar Year were outlined. Professor R. G. Aitken, director of the Lick Observatory, presented the review on "Astronomy and Astrophysics." Attention was given to some of the major problems of stellar research, such as the distribution of stars, their spectral peculiarities and distances, their apparent and absolute magnitudes and radial velocities. The bearing of these investigations on current theories of the nature of the universe was discussed. Several recent observations of general interest were referred to: the meteoric shower of last November, night sky radiation, bands identified in the spectra of Venus and Jupiter, the total eclipse of August 31, and observation of the corona without eclipse. Professor Eliot Blackwelder, of Stanford University, reviewed the recent contributions in geology and seismology, selecting five or six problems of major interest which are being actively investigated in the west. Among these might be mentioned the nature and origin of batholiths, the origin of the characteristic plains of deserts and certain problems of mountain growth. The final review on "Chemistry in Relation to Medicine" was presented by Dr. Chauncey D. Leake, professor of pharmacology in the University of California.

In the evening Professor W. F. Durand, of Stanford University, retiring president of the Pacific Division, presented an address on "The Development of our Knowledge of the Laws of Fluid Mechanics." This will be published *in extenso* in SCIENCE. Prior to President Durand's address, Dr. George Thomas, president of the University of Utah, formally welcomed the association and its guests.

The morning of Tuesday, June 13, was devoted to a symposium on "Scientific Problems of the Great Salt Lake," in which five papers of considerable interest were presented by members of the faculty of the University of Utah whose studies have been largely centered upon the problems under discussion. The titles are "The Ancestry of Great Salt Lake," Dr. Hyrum Schneider; "Climatological and Hydrological Problems," T. C. Adams; "Chemical Deposits and Problems," Dr. Thomas B. Brighton; "Animal Life and Relations," Dr. A. M. Woodbury, and "Plant Life and Relations," Dr. Walter P. Cottam.

At 4 P. M. President and Mrs. Thomas received the members and guests of the Division and associated societies. In the evening, Dr. H. H. Kimball addressed the association on "Meteorology—Ancient and Modern; its Development and Applications." The address was largely devoted to the growth of observational and experimental work in meteorology as conducted under the auspices of various government departments from 1812 on.

The concluding evening address on "Earthquake Habits of Many Lands" was presented on Wednesday, June 14, by Professor Bailey Willis, of Stanford University. Attention was given to the origin of earthquakes, the hypotheses prevalent among the ancients, and the newer theories which attribute earthquakes to slips along recognized faults under the influence of excessive lateral pressure in the outer shell of the earth. The earthquakes of various regions were discussed in some detail.

Six excursions to adjacent areas of scientific and scenic interest were made during the course of the meetings. These trips included the Timpanagos scenic loop—one of the most picturesque mountain highways in Western America, the Bear River game refuge, which serves as an important breeding area for wild fowl and aquatic birds in the West, and Bird Island in Great Salt Lake, where countless numbers of wild fowl—the sea gull, pelican, cormorant and blue heron—make their nests. The large open-cut copper mine at Bingham and the smelter at Garfield were visited. Members interested in geology enjoyed a trip to the beautiful Little Cottonwood Canyon, while an excursion into Tooele Valley gave opportunity for observing various stages of plant succession, from the extreme halophytic pioneers to the desert climax types.

Business sessions of the Pacific Division of the American Association for the Advancement of Science, the executive committee and the affiliation committee were held. At the general business sessions on June 13, Professors A. O. Leuschner and A. R. Davis, of the University of California, were elected to the executive committee in succession to Dr. J. H. Moore and Professor R. E. Clausen, who are retiring after five years of service. A resolution of gratitude for the generous hospitality of the University of Utah was unanimously adopted. Announcement was made that the meeting of 1934, which will be held in Berkeley, California, in June, will be a national meeting of the entire association. At the meeting of the executive committee on June 14, Professor Joel H. Hildebrand, of the University of California, was elected to the presidency of the Division for the ensuing year. Professors E. G. Martin and J. Murray Luck, of Stanford University, were re-elected vice-president and secretary-treasurer, respectively.

Dr. R. V. Chamberlin, Dr. T. B. Brighton, L. L. Daines, Dr. D. A. Lyon, H. L. Marshall, Dr. F. J. Pack and Dilworth Walker served as chairmen of the committees in charge of the local arrangements.

The reports of the scientific sessions of participating societies follow:

American Association of Economic Entomologists, Pacific Slope Branch

(Report by H. A. Scullen)

A total of twenty-four papers were listed on the program. Dr. George F. Knowlton and M. J. Janes gave a report on studies relating to the food habits of lizards, showing them to be important predators of the beet leafhopper. R. A. Fulton reported on studies relating to the fat content of *Eutettix tenellus* Baker and its relation to hibernation and overwintering ability. An interesting case of "Insect Tolerance" was reported on by Dr. R. L. Webster. Evidence was presented to show a developing tolerance to oil-lead arsenate sprays by the San Jose scale.

The Thursday program began with the presentation of two papers by A. F. Swain. The first was entitled, "Detection and Measurement of Surface Oil on Citrus Following Spraying," by A. F. Swain and Don Green. The second was a report on "A Study of the Possibility of Increasing the Toxicity of HCN by the Addition of Auxiliary Gases," by F. S. Pratt, A. F. Swain and D. N. Eldred. Common species of Coccinellidae were used in these studies. Russell S. Lehman gave a progress report on work being done on fumigants for the wireworm, *Limonius californicus* Mann. The efficiency of thirteen fumigants compared with carbon disulfide were studied under controlled conditions. Latest methods of applying liquid sprays by airplane were presented in a paper by Frank B. Herbert. Some results from studies on the pea weevil in the Pacific Northwest appeared in two papers. T. A. Brindley presented a paper on "Some Notes on the Biology of the Pea Weevil, *Bruchus pisorum* L. (Coleoptera, Bruchidae) at Moscow, Idaho," and A. O. Larson, T. A. Brindley and Frank G. Hinman, a paper on "The Local Dispersal of the Pea Weevil." Laboratory studies on the effects of low temperature on the adults of the Colorado potato beetle and its possible relation to the northern spread of that insect were reported on by Professor G. Allen Mail and R. M. Salt. In a paper on "The Identity of Two *Lygus* Pests (Hemiptera, Myridae)," Dr. W. E. Shull raises *Lygus etisus* Van Duzee and *L. hesperus* Knight to the rank of species and new common names are proposed. Dr. Shull also presented a paper on "A Method of Inhibition of Coagulation in the Blood of Insects" by exposure to vapor of acetic acid. In a paper presenting results from studies on ants associated with aphids, Dr. Charles R. Jones showed that species and genera of ants mixed freely with those of other species and genera. The life history, distribution and control of the western yellow willow tingid (*Corythucha salicata* Gibson) was discussed in a paper by B. G. Thompson and K. L. Wong. The

results of tests on the control of the pepper weevil by various fluorine compounds were presented in a paper by J. C. Elmore. Comparative studies have recently been made with various types of spray tank agitators and the results of these studies were given in a paper by Arthur D. Borden.

On Wednesday afternoon the visiting entomologists were taken on a field trip to observe the alfalfa weevil problem under the able leadership of entomologists working with that insect.

The following officers were elected for the ensuing year: *President,* George I. Reeves; *vice-president,* W. B. Herms; *secretary-treasurer,* H. A. Scullen.

The 1934 meeting will be held at Berkeley in connection with the Pacific Division of the American Association for the Advancement of Science.

American Chemical Society, Pacific Intersectional Division

(Report by C. R. Kinney)

Sixteen papers were presented. The first was by Professor O. F. Stafford on the solvent properties of acetamide. Predicting that acetamide would have good solvent properties because of the different groups present, Dr. Stafford tested the solubility of some 400 substances and discovered that only about 4 were insoluble. Dr. G. W. Sears with F. Lohse described the results of their study of the reaction between tungstic acid, chlorine and carbon, in which the carbon appears to act as a catalyst and not as a reducing agent. Dr. J. W. McBain gave two very interesting papers; the first, with C. R. Dawson, was on "Accelerated and Retarded Diffusion in Aqueous Solutions." The sintered glass cells that were used were exhibited and values for the diffusion of certain ions were given. The second paper on the "Air-driven Ultracentrifuge" was particularly interesting to those who had not seen the apparatus before. R. C. Swain reported his findings on "The Measurement of Absolute Adsorption by the Microtome Method." A slide showing the elaborate apparatus provoked particular interest.

At the beginning of the Wednesday morning meeting, Dr. Merle Randall abstracted a paper on "The pH Buffering Power of Several Vegetables" by G. L. Marsh and Dr. W. V. Cruess. The next two papers were on complex cyanides by Dr. W. D. Bonner and associates. The first, with M. J. Miles, gave the results of a determination of the composition of the complex nickel cyanides. The second, with Dr. S. F. Ravitz and M. J. Miles, described the results of a study on the "Complex Cupro-Cyanide Ions and the Silver Iodide Complex Ions." Two papers on organoboron compounds were presented by Dr. C. R. Kinney, H. T. Thompson and T. M. Burton. Dr. G. S. Parks gave a very interesting paper on "The Coefficient of Thermal Expansion of Boron Trioxide," in which values were given at various temperatures over the softening range of boron trioxide. At these temperatures the coefficient of expansion rose very rapidly. Dr. Kenneth A. Kobe presented two papers on furan. The first, with K. W. Gerstmann, dealt with polymerization of furan and the second, with C. S. Huey, contained evidence that the oxygen of furan was conjugated with the carbon atoms of the ring. Two papers, on the "Hydration of Wood Pulp in Zinc Chloride Solution," by Professor W. L. Beuschlein and B. L. Rauschert, and "A Study of Adsorption at the Benzene-Sodium Oleate Solution Interface," by K. M. Seymour, K. A. Wright and Dr. H. V. Tartar, were read in abstract. The last paper was by Dr. J. R. Lewis, on "The Use of Analogies in Teaching Chemistry."

The executive committee for the coming year will be Dr. J. L. St. John, State College of Washington, *chairman;* Dr. C. R. Kinney, University of Utah; and Dr. G. K. Rollefson, University of California (newly elected member). Dr. Rollefson will also be chairman of the program committee for the Berkeley meeting, 1934. The results of the annual high-school chemistry contest were not available for announcement at the dinner, but may be included now. Professor R. K. Strong, of Reed College, was in charge of the contest. First place and the loving cup went to the high school of Ashland, Oregon. Second and third places went to Folsom City, California, and Snohomish, Washington, respectively.

American Meteorological Society

(Report by J. Cecil Alter)

Dr. Herbert H. Kimball presided. Dr. Hyrum Schneider gave an extemporaneous talk on "Weather Observations as Laboratory Material in Teaching Climate," showing particularly the relationship between local sky and other signs and the daily weather map. The talk gave rise to a general discussion of weather forecasts.

S. R. Boswell's paper, "Settling Weather Disputes," was read by Blaine N. Ramsden, and set forth the many ways in which a county agricultural agent, who is also a cooperative weather observer, disseminates the facts about the weather, replacing tradition, belief and mistaken impressions; and especially how a knowledge of temperatures and rainfall enable the county agent to advise the farmers in regard to watering, cultivating and harvesting crops. "Lights and The Weather Man," by L. B. Fuller and H. H. Krueger, described the various ways in which wind, rain, snow and temperature changes stretch, sag, whip and break or "short" electric transmission wires, and how precipitation and especially deposits there-

from will cause short circuits over the best of insulators. J. Billeter gave a paper on "The Effect of Meteorological Conditions upon the Formation of Salt Lake City's Smoke Cloud," showing especially where the smoke originated, and how it was gathered by winds over a certain part of the city. Sunny days and high barometric pressures, by convectional action, aided in increasing the depth of smoke. Some ingenious but futile methods were reported for ridding the city of smoke; it can in fact be lessened only by reducing the amount generated in homes and large heating plants. Clarence R. Kallquist read a paper on "Results of Pilot Balloon Ascensions above the Arctic Circle," showing wind movements over Greenland especially. This paper brought out a general explanation of the so-called Polar Year of cloud and upper air meteorological observations, especially within the Arctic Circle. The contribution of cloud photographs to the Polar Year program was explained by F. L. Disterdick; Mr. Floreen's exhibit of cloud photographs made at Cheyenne was on display.

After some discussion of lenses and methods of photography, F. L. Disterdick exhibited an automobile wind-shield that had been sandblasted and deeply pitted by a severe Wyoming sand storm. Hundreds of automobiles were cleared of their paint, and their glass parts rendered opaque by the sandblasting. After an explanation of the Polar Year program, Dr. H. H. Kimball gave a paper on "The Use of Glass Color-Screens in the Study of Atmospheric Depletion of Solar Radiation," which explained how oblique rays of the sun encountering atmospheric dust, moisture and other obstruction can be reduced to vertical or normal rays for the place. Ralf R. Woolley presented a paper on "Some Historic Floods in Utah," gleaned from sequestered records prior to those of precipitation and stream measurement. The floods referred to occurred in Utah mostly between 1850 and 1890, the author pointing out that floods occurred as frequently then as now, and that the works of man or his utilization of the watersheds do not prevent or augment flooding. In the animated discussion which followed, the parts played by controlled grazing and forestry in flood control received attention. Dr. Wayne B. Hales presented the results of a balloon study with a portable anemometer of the canyon winds of the Wasatch mountains. He showed the advantages to agriculture of the canyon winds in prolonging the frost-free season and in preventing the extremes of diurnal temperatures that would otherwise occur. "The Unseasonable Fire Weather in October, 1932, in Western Oregon," was the subject of a paper prepared by Charles I. Dague, and read by Blaine N. Ramsden. This set forth the extraordinary occurrence of extreme desiccation in a region normally very wet or moist, and emphasized the fact that low humidity, more than wind, was the cause of increased fire hazards. "An Exact Method of Eliminating the Annual Cycle from Temperature Data," by Jesse W. Smith and Joe R. Fulks, presented a statistical method of smoothing temperature curves which is claimed to be more useful than ordinary methods. The paper on "Some Meteorological Fluctuations of Ground-Water Levels," by George H. Taylor, explained how daily, yearly and secular trends in precipitation, evaporation and transpiration affect ground water levels, and consequently the stages in wells under observation. Irregular barometric pressure changes were shown to be especially effective in producing changes in the water level in some wells, and changes also were noted during and after an earthquake.

A. B. Purton presented a paper on "Transpiration and Stream Flow," in which he reported and explained the phenomenon of willows absorbing by transpiration the greater part of the flow of a small stream during the daytime, allowing the stream to rise appreciably at night. Thomas C. Adams read a paper on "Evaporation from Great Salt Lake," in which new data on the general subject of evaporation in different seasons of the year and the results of laboratory studies on exaporation from fresh and salt water were presented. E. G. Thorum explained in a paper on "Forecast of Spring Run-off in Streams of the Western United States from Precipitation Data at Indicator Stations," how a few selected precipitation stations in the lower, settled country are used in predicting the early summer flow of Bear River, a large Utah-Idaho-Wyoming mountain stream intensively used for hydroelectric purposes.

A paper on "Earthquake Weather in Southern California," by Dr. Charles C. Conroy, was read by J. Cecil Alter. The paper showed by numerous comparisons and correlations that earthquakes could not be associated with any combination or characteristic of weather elements, unless it should be proved "that the axis of the prevailing (pressure) gradient is nearly perpendicular to the line of the involved fault." Carl Elges presented the last paper on "Forecasting the 1933 Runoff in the Humboldt Basin, Nevada: a Study in Great Basin Hydrology," showing how stream discharges are predicted by the snow survey system. The paper emphasized the methods of correcting the indicated flow by the consideration of factors other than snow supply.

AMERICAN PHYSICAL SOCIETY, 185TH MEETING

(Report by Leonard B. Loeb, secretary for the Pacific Coast)

The sessions began at 9 o'clock on the morning of June 15 and extended until noon. The sessions re-

sumed at 1:30, to continue as a joint symposium with the Astronomical Society of the Pacific, there being four papers presented by invitation. The titles were as follows:

High terms in the spectra N^v and O^v: WILLOUGHBY M. CADY, California Institute of Technology.

Hyperfine structure and nuclear moment of Columbium: DR. NORMAN S. GRACE and STANLEY S. BALLARD, University of California at Berkeley.

Hyperfine structure of Molybdenum: DR. NORMAN S. GRACE and KENNETH R. MORE, University of California at Berkeley.

Hyperfine structure and nuclear spin of Lanthanum: DR. H. E. WHITE and A. E. ANDERSON, University of California at Berkeley.

Remarks on the "lines" of diffraction gratings: HAROLD D. BABCOCK, Mount Wilson Observatory.

Measurement of the Townsend coefficients for ionization by collision: FREDERICK H. SANDERS, University of California at Berkeley.

Uranium and thorium content of rocks determined from their surface radiation: ROBLEY D. EVANS, University of California at Berkeley.

The heat of dissociation of Bi_2 determined by the method of molecular beams: CHENG CHUAN KO, University of California at Berkeley.

Charging devices for portable ionization electroscopes: DR. E. J. WORKMAN, Reed College.

The study of a powerful source of positive alkali ions: PAUL KECK and DR. LEONARD B. LOEB, University of California at Berkeley.

Azimuthal investigation of the cosmic radiation: S. A. KORFF, Mt. Wilson Observatory.

Photographic studies of the planets in light of different wave-lengths: DR. W. H. WRIGHT.

Spectra of Mars, Venus and Jupiter under high dispersion: DR. T. DUNHAM.

Molecular spectra in the photographic infra-red: DR. D. M. DENNISON and A. ADEL.

Radioactivity and the age of meteorites: R. D. EVANS.

There were some twenty members of the Physical Society in attendance, covering institutions from Los Angeles, central California and Utah. It was voted to hold the 188th meeting on Friday, December 15, and Saturday, December 16, 1933, at Stanford University, California.

Members of the Physical Society met at an informal luncheon at the Union on June 15 and an informal dinner at the Union on June 17. The small attendance at these meetings was largely a result of the economic conditions throughout the country, together with the fact that a very much larger meeting was being held a week later in affiliation with the American Association at the Century of Progress Exposition in Chicago. A large percentage of the papers which would normally have come to the meeting of the Pacific Division were thus reserved in order to make it possible for members to attend the 186th meeting in Chicago. Despite its small size, the meeting was highly successful and the papers were of excellent quality, especially so in the case of the joint symposium of the Astronomical Society of the Pacific and the American Physical Society. It was felt by members of the society, both from the population centers and from the local community, that the contacts made were mutually beneficial to all concerned, and that despite the small attendance at the meetings in the smaller institutions, these meetings served an exceedingly useful function in stimulating scientific advance.

AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS, WESTERN DIVISION

(Report by Lawrence E. Griffin)

The following papers, briefly abstracted, were presented:

Herpetological Habitats and Life Zones in Mexico: PAUL D. R. RÜTHLING, Santa Fe, New Mexico. Temperature and water seem to be the chief factors determining life zones in Mexico. Temperature varies according to latitude, elevation and exposure, causing greater restrictions to distribution than light, atmospheric pressure and other minor factors, and is of great influence in molding environment and creating barriers. A brief sketch is given of the west coast, Lower California, east coast, central plateau, and isolated Alpine regions, together with comments on the herpetological fauna typical of these distinct regions.

A plea for the systematic lumper: ROLF L. BOLIN, Hopkins Marine Station. There exists too large a proportion of monotypic genera, a considerable number of which should be lumped in order to best display the relationship of the forms in question.

Distribution of the fishes of Oregon and Washington: L. F. SCHULTZ, University of Washington. Three hundred forty-seven species of fish have been taken in this area, 255 marine, 75 fresh-water and 17 common to salt and fresh water. Twenty-one species of marine fish have not been found outside the area; 11 of these occur in Puget Sound. The Columbia River has 33 native species and 16 introduced. In general the fauna of the coast of Washington, Puget Sound, and the coast of Oregon as far south as the Sixes River was derived from the Columbia River. The Rogue River, Klamath River and Oregon Lakes possess a distinct fauna.

A study of the variation of the dorsal scale rows of Charina bottae (Blainville): DR. VASCO M. TANNER, Brigham Young University. After a study of 120 specimens of the rubber snakes found in the eight western states, it was concluded that the evidence at present supports the contention that the öoids of this region should be considered as one species; also that the Utah specimens are not sufficiently distinct from other specimens taken throughout the western states to warrant being considered as a subspecies.

Notes on the native fish fauna of Utah: DR. VASCO M. TANNER. Utah has mainly two drainage basins, the Great Basin or Bonneville Basin and the Colorado River Basin. Twenty-nine native species, 23 introduced species, and 7 fossil species are reported.

Notes on the Catostomids of Utah: MERRILL C. HAMMOND, Brigham Young University. In the Colorado River system are found *Xyrauchen texanus, Catostomus latipinnis, C. insignis, Notolepidomyzon utahensis,* and *Pantosteus delphineus. Pantosteus platyrhynchus* is found in the Provo, Sevier and Weber Rivers. *Pantosteus virescens* is common in the Weber and Bear Rivers. *Catostomus ardens* may be a synonym of *C. fecundis; Chasmistes liorus* may be only a variant of *Catostomus fecundis.*

The mechanism of fang replacement in the rattlesnake: L. M. KLAUBER, Natural History Museum, San Diego, California. On each side of the head there is a pair of contiguous maxillary fang sockets. These are used alternately to hold the active fang, the immature fangs being held in a magazine in a staggered line behind the two sockets, the most mature of the future fangs being behind the vacant socket. When the time comes for a change this fang advances to the vacant socket anterior to it and becomes seated therein. The old fang drops out, leaving a vacant socket, to which, in due time, the next replacement advances.

Notes on some Washington amphibians: JAMES R. SLATER, College of Puget Sound. *Ambystoma tigrinum* has been taken in the larval condition in Sulphur Lake and Medical Lake, Wash. They are taken in large numbers at Medical Lake. *Rhyacotriton olympicus, Ascaphus truei, Ambystoma paroticum,* and *Bufo boreas* were taken at Spirit Lake, Wash. *Plethodon intermedius* was taken north of any previously reported locality, near Pokum, B. C.

The Muellerian duct of the male Triturus torosus: DR. LAWRENCE E. GRIFFIN and HENRY WU, Reed College. The Muellerian duct of the male Triturus is an extremely slender tube which extends the length of the abdominal cavity, and has a definite lumen as far as its anterior extremity.

Infection with amphibian tubercle bacilli connected with a case of sex reversal in a frog: DR. LAWRENCE E. GRIFFIN, Reed College. A testis of normal appearance and connections replaced the right ovary. In the testis were found numerous masses of bacteria which have been identified as amphibian tubercle bacilli.

Some changes in the blood of certain Caudata, Triturus torosus, during desiccation: ALICE H. BRAMLETT and DR. F. M. BALDWIN, University of Southern California. A study made to discover the degree of desiccation as indicated by changes in concentration of blood cells, increase in specific gravity, and coagulation time. Rapid desiccation is fatal. In some cases death resulted when 32 per cent. of the body weight was withdrawn in 14 hours. When desiccation was carried out slowly, some lived 54 hours with a loss of weight of 38 per cent.

Notes on a new Cyprinoid genus, Pseudogyrinocheilus; and P. procheilus (Sauvage and Dabry) from western China: P. W. FANG, Metropolitan Museum of Natural History, Nanking, China. A detailed analysis and description of the new genus and of the species assigned to it.

An exhibition of living reptiles of Utah was prepared by Dr. Vasco M. Tanner and D. Eldon Beck.

Officers for the coming year were elected as follows: *President,* Dr. Vasco M. Tanner; *vice-president,* Dr. Tracy I. Storer; *secretary,* Dr. Arthur Svihla.

(To be concluded)

SCIENTIFIC EVENTS

BRITISH BOTANICAL EXPEDITION TO TURKEY

THE correspondent of the London *Times* from Constantinople records that E. K. Balls and W. Balfour Gourlay have returned from an expedition in Anatolia in search of plants for the Royal Botanic Gardens at Kew and in Edinburgh. They set out in March with field kit, an English-speaking chauffeur, and a second-hand car which they had bought in Constantinople. Their first objective was the Taurus region, but finding their movements there somewhat restricted by the local authorities they returned to Angora and explored the country surrounding Kirshehr, Kaisarieh, Sivas, Erzinjian and Gümüshané. Here they found flora akin to that of Persia. At the end of May they had made their way to the Trebizonde vilayet, where the climate is less dry than in Central Anatolia and consequently the flora is more luxuriant. There they worked until September 9 from sea-level up to 11,000 feet.

In spite of an unusually wet and late summer, Mr. Balls and Mr. Gourlay are highly satisfied with the results of their expedition. They have discovered new varieties of crocus, tulip, primula and alpine plants; rare lilies and foxgloves. Two perennial foxgloves, one white and yellow, and the other yellow and brown, and a golden autumn-flowering crocus growing on the borders of Lazistan they regard as their greatest finds. Masses of pale-blue hyacinth growing in a bog and from a distance resembling a sheet of shimmering water supplied the most striking sight of their travels.

At regular intervals during the summer they posted home seeds, bulbs and live plants, and nearly all arrived in good condition. Both spoke very warmly of the hospitality they received in all the villages they

visited. Not only did the villagers entertain them, but they also assisted them in their search for flowers and plants. Many of them showed great knowledge of plants and their use as food or medicine. Mr. Balls and Mr. Gourlay were particularly impressed by the honesty they met among the peasants and shepherds.

RUSSIAN ASCENT TO THE STRATOSPHERE

ACCORDING to an Associated Press dispatch from Moscow, government wireless stations announced on September 30 that the balloon *Stratostat* had landed safely in a meadow near Kolomna, 71 miles from Moscow, after having completed a flight which carried it 19,000 meters, or 11.80 miles above the earth for a new altitude record.

The three Russian balloonists who took off in the army balloon at 8:41 A. M. on September 30 were greeted by cheering peasants as they landed.

All issued a statement in which they said they were proud to have beaten the world's altitude record of 16,700 meters, or 10.38 miles, set by Professor Auguste Piccard in August, 1932.

Another wireless from the descending craft placed its altitude at 8½ kilometers, about 5.3 miles, and added that the airmen expected to land in the vicinity of Bronitzky, 56 kilometers, or about 31 miles, southeast of Moscow.

The balloonists, Georgi Prokofiev, Ernest Birnbaum and Konstantin Gudenoff, had made eight previous attempts to get their craft off the ground, but this time, thanks to perfect weather, they had easy sailing.

Five messages sent while they were soaring aloft told of their rapid progress upward. About two hours, 19 minutes after they took off they wirelessed they had bettered the Swiss natural scientist's altitude and were still rising.

They had then drifted only 24 kilometers from the straight line upward and said the equilibrium of their craft was good. They did not complain of the cold, although at that great height the temperature inside their gondola was 22 degrees below zero, centigrade, and the outside temperature was 65 degrees centigrade below.

The craft, the "U. S. S. R.," got away smoothly. Only a few persons were at the field, but thousands saw the silver-blue bag disappear shortly after nine o'clock. The crew wore heavy fur-lined, three-quarter length coats, felt boots of knee-length and regulation aviator's helmets.

The balloon is of rubberized percale and has a gas capacity of 25,000 cubic meters. The gondola, of aluminum, is ball-shaped, with nine windows. Besides radio equipment it has liquid oxygen for three men for 40 hours, and numerous natural scientific instruments which function automatically.

LIMITATION OF CASH WITHDRAWALS FOR THE DEPARTMENT OF AGRICULTURE FOR 1934

CASH withdrawals from the Treasury by the Department of Agriculture during the fiscal year 1934, as announced on June 19, will be limited to $60,000,000 or 37 per cent. less than for 1932. This amount is for the regular work of the department and for federal aid to the states for experiment stations, extension and forestry, but does not include funds for roads or for expenditures under the Agricultural adjustment act.

The following table shows the funds allotted to the various bureaus and for other purposes:

	Appropriation 1932	Appropriation 1933	Appropriation 1934	Limitation on cash withdrawals 1934
A. Ordinary Activities:				
Office of the Secretary	$ 1,322,115	$ 1,206,547	$ 1,164,561	$ 1,029,442
Office of Information	1,420,961	1,335,800	1,226,287	916,966
Library	110,620	106,100	100,223	88,901
Office of Experiment Stations	399,410	294,294	226,961	198,670
Extension Service	1,793,560	1,688,170	1,583,822	1,189,267
Weather Bureau	4,497,720	4,164,038	3,731,235	2,909,884
Bureau of Animal Industry	16,085,195	15,324,947	14,398,524	11,778,135
Bureau of Dairy Industry	796,990	717,448	655,130	545,000
Bureau of Plant Industry	5,839,238	4,930,874	4,496,155	3,728,195
Forest Service	15,184,620	10,780,924	9,952,610	7,645,559
Bureau of Chemistry and Soils	2,104,051	1,925,080	1,766,458	1,470,305
Bureau of Entomology	2,863,740	2,471,700	2,213,968	1,729,241
Bureau of Biological Survey	2,229,170	1,756,177	1,356,280	1,017,261
Bureau of Agricultural Engineering	656,990	618,690	508,206	423,971
Bureau of Agricultural Economics	7,241,136	6,649,841	6,095,260	4,497,150
Bureau of Home Economics	246,700	233,365	212,749	169,338

Bureau of Plant Quarantine	3,747,930	2,490,125	2,158,514	1,797,694
Grain Futures Administration	221,480	218,838	200,000	166,639
Food and Drug Administration	1,810,228	1,716,167	1,589,505	1,493,000
Total, Ordinary Activities	**$68,571,854**	**$58,629,125**	**$53,636,448**	**$42,794,618**
B. Payments to States, Etc.:				
Experiment stations	$ 4,357,000	$ 4,374,000	$ 4,381,000	$ 3,285,750
Extension work	8,672,936	8,728,096	8,738,096	6,553,572
Cooperative forest fire prevention	1,775,000	1,611,580	1,587,513	1,190,635
Distribution of forest planting stock	95,000	79,960	74,730	56,047
From National forest receipts, contributed, and other special funds	4,015,500	3,555,475	3,087,020	2,469,616
Total, Groups *A* and *B*	**$87,487,290**	**76,978,236**	**71,504,807**	**56,350,238**
C. Special Items:				
Forest fire deficiency	4,260,000	3,087,020	2,000,000(a)	2,000,000(a)
D. C. rent	.....	.....	25,000(b)	25,000(b)
Estimated special non-recurring cash carry-over	1,814,300(c)	1,814,300(c)	1,814,300(c)	1,814,300(c)
Comparable Grand Totals	**$93,561,590**	**$81,879,556**	**$75,344,107**	**$60,189,538**

(a) Rough estimate for forest fire deficiency, based on five-year average.

(b) Rough estimate of supplemental appropriation based on special provision in Agricultural Appropriation Act, 1934.

(c) Rough estimate, based on survey of probable carry-over for payment in 1934 of non-recurring obligations of prior years; including acquisition of land and other special items; this figure included in appropriation columns to provide for comparability of grand totals.

THE NORTHWEST RESEARCH FOUNDATION AND THE UNIVERSITY OF MINNESOTA

THE way to a series of scientific researches that may open important and valuable industrial opportunities in the Northwest was opened at a meeting of the Board of Regents of the University of Minnesota, when that body approved the contract between itself and the Northwest Research Foundation. The foundation, whose membership is made up of leading business men of the Twin Cities and the Northwest, will raise a fund with which to investigate the commercial possibilities of regional raw materials not now being utilized to the full.

A campaign to raise funds for the foundation is expected to be launched shortly. It will be announced by the officials of that organization. James Ford Bell, chairman of General Mills, Inc., is its head.

More than a year ago the University of Minnesota pointed out that such raw materials as lignite, the aspen or "popple" forests of northern Minnesota, the peat deposits of this state, and the millions of bushels of grain of inferior grade that are a part of every crop, should be examined with detailed care to determine what commercially useful products could be made from them. There are other materials, also, worthy of consideration, among them casein, of which millions of pounds are available in Minnesota creameries and cheese factories.

The plan of the foundation is that it shall raise money to be turned over to the University of Minnesota for use in research. If a discovery is made and patented, it may be turned over to a manufacturing concern under a licensing system. From the proceeds or royalties from this license, the first money will be used to reimburse the donated fund for the cost of the research. In the second place, the donors will be reimbursed. Money over and above the amount needed for these purposes will be divided into two equal parts, half of which will go to the university outright, while the second half will go to the foundation as a fund with which to finance further scientific researches. Thus if a license should produce $100,000 after $10,000 had been spent on the original research, the foundation would get back its $10,000, the donors would be reimbursed in like amount for their donations, but without interest, and of the remaining $80,000 there would be $40,000 outright for the university and $40,000 to finance further researches for the foundation.

Professor Lloyd H. Reyerson has been the prime mover in the project from the university's side. He has had, during the past year, cooperation of a faculty committee, appointed by President Coffman, and from the group of business men who plan to finance the plan.

The resolution of the Board of Regents, entering into the agreement, reads as follows:

WHEREAS, A group of public-spirited citizens have associated themselves and organized the Northwest Research Foundation as a non-profit institution established to promote researches designed to improve the economic life of the Northwest, and

WHEREAS, The Northwest Research Foundation proposes to support researches at the University of Minnesota having for their object the development of new uses for the natural resources and products of the State of Minnesota and the Northwest,

Be it Resolved, That the Regents of the University of Minnesota approve and authorize the proper officers to execute the following memorandum of agreement between the Northwest Research Foundation and the University of Minnesota.

Be it Further Resolved, That the Regents of the University of Minnesota direct the president of the university to create within the university a research institute to be known as the Northwest Research Institute which shall have the responsibility of carrying into effect the terms of this agreement. The institute shall be administered by a director who shall be appointed by the president of the university, subject to the approval of the Board of Regents.

CHEMISTRY AND GEOLOGY AT THE BOSTON MEETING OF THE AMERICAN ASSOCIATION

THE Section of Chemistry of the American Association for the Advancement of Science, which meets in Boston from December 27 to January 2, will have three sessions for contributed papers. One of these will be devoted to physical chemistry and another to chemistry related to biochemistry and medicine.

For a joint session with the Section of Social and Economic Sciences a symposium has been arranged entitled "The Chemical Revolution." It will deal with the economic significance of chemistry. Papers will be given concerning the repercussions of chemical changes upon international trade, the effects of chemical progress upon the relations between industries, the economic readjustments resulting from progress in chemical technology, and the possible future economic changes indicated by our present research progress.

The address of the retiring vice-president, Dr. Frank C. Whitmore, on "Some General Aspects of the Polymerization and Depolymerization of Olefins," will be given at 2 o'clock on the afternoon of December 29. In the evening the Northeastern Section of the American Chemical Society will cooperate with Section C in an informal dinner and evening meeting, when it is expected that an address will be given on the subject of "Nutrition."

Professor Arthur B. Lamb, of Harvard University, is vice-president of the association and chairman of the section; J. H. Simons, 6217 N. Talman Avenue, Chicago, Illinois, is secretary. Titles and abstracts of contributed papers should be in the hands of the secretary before November 20.

Titles of papers, accompanied by abstracts of approximately two hundred and fifty words, intended for presentation at the meeting of Section E, geology, should be submitted to Dr. Kirtley F. Mather, secretary of Section E, Geological Museum, Cambridge, Massachusetts, not later than November 15. Section E will meet for the reading of technical papers during the forenoon and afternoon of Wednesday, December 27. If necessary an additional session will be held on Thursday morning. The address of the retiring vice-president, Professor William H. Hobbs, of the University of Michigan, will be delivered at 11:00 A. M., on December 28. It is expected that the majority of papers on the program will deal with the geology of New England and topics related thereto.

RECENT DEATHS

DR. SAMUEL FRANKLIN ADAMS, of New York City and White Plains, specialist in internal medicine and until two years ago head of the metabolism division of the Mayo Clinic at Rochester, Minnesota, died on September 28, at the age of thirty-seven years.

DR. ARTHUR DERMONT BUSH, professor of physiology and pharmacology at Emory University until his retirement in 1927, died on September 6, at the age of fifty-eight years. Dr. Bush had previously been connected with Olivet College and the universities of Southern California, Missouri and North Dakota.

JOHN EDWARD MARR, emeritus professor of geology at the University of Cambridge, died on October 2, at the age of seventy-six years.

WILLIAM HOPE FOWLER, the British radiologist, died on October 5, at the age of fifty-seven years. Although he had retired at the age of fifty years as chief surgical radiologist of the Edinburgh Infirmary, he continued to carry on his experiments with radium. His death was directly due to this work.

DR. F. S. PEPPERDENE, the well-known British radiologist, died in Quebec on September 25 of x-ray burns. He was seventy years old.

DR. P. EHRENFEST, professor of theoretical physics at the University of Leiden, committed suicide on September 25.

SCIENTIFIC NOTES AND NEWS

THE degree of doctor of science was conferred by Lehigh University on October 4 on Dr. Hans Zinsser, professor of bacteriology and immunology at the Harvard Medical School. Dr. Zinsser gave on that day the Founders' Day address.

PROFESSOR EDWARD W. BERRY, vice-president of the Johns Hopkins University, has returned to Baltimore after spending the summer in Venezuela. While there he was awarded a gold medal by the Venezuelan Ministry of Education.

DR. HERMANN PRINZ, professor of pharmacology at the School of Dentistry, University of Pennsylvania, has been appointed a fellow of the Academy of Science at Halle. Dr. Prinz is one of the five dentists who are members of the academy, the others being Drs. Walkhoff and Schroder, of Berlin; Euler, of Breslau, and Hess, of Zurich.

DR. E. O. LAWRENCE, of the University of California department of physics, has been invited to be the American speaker at the Solvay International Institute of Physics at Brussels, which holds a seven-day session beginning on October 22. He will present a paper on "The Structure of the Nucleus and the Disintegration of Atoms," based on recent work done in the radiation laboratory of the department of physics at the University of California. The Solvay Institute was endowed in 1912, and since 1913 has held sessions every three years, with the exception of the war period. Some twenty of the foremost European physicists are invited to appear at each meeting, and one American.

MEDICAL societies in the Bronx and Queens and health officers of the two counties plan to celebrate the twentieth anniversary of the first production of toxin-antitoxin for the prevention of diphtheria on October 24 and 26. Dr. William H. Park, director of the bureau of laboratories of the Department of Health, a pioneer in the work of diphtheria prevention, will be honored at both gatherings, as will Dr. Béla Schick, discoverer of the test by which it is possible to determine whether or not an individual is immune to the disease. Memorials signed by thousands of immunized children in the two boroughs will be presented to Dr. Park. The presentations at that time will mark the close of a current anti-diphtheria campaign now being conducted by health groups in the Bronx and Queens.

AT the last general meeting of the International Association for Dental Research the following officers were elected for 1933–34: *Honorary vice-presidents,* Jan Jesensky, Prague; Hans Pichler, Vienna; J. G. Turner, London; *President,* Edward H. Hatton, Northwestern University; *President-elect,* J. L. T. Appleton, University of Pennsylvania; *Vice-president,* Theodore B. Beust, University of Louisville; *Treasurer,* Bissell B. Palmer, Fifth Avenue Hospital (N. Y.); *Secretary,* William J. Gies, Columbia University.

DR. NICHOLAS KNIGHT has resigned from the faculty of Cornell College after thirty-five consecutive years of teaching in the school. As head of the department of chemistry, Dr. Knight is largely responsible for the development of the six modernly equipped laboratories.

AFTER more than forty years' service, during twenty-three years of which he was director and chief chemist of the department of chemistry of the Clemson Agricultural College of South Carolina, Dr. Richard Newman Brackett retired on July 1, at the age of seventy years. He has been made special professor of the history of chemistry in charge of the chemical library.

DR. WILLIAM M. JARDINE, retiring ambassador to Egypt and formerly Secretary of Agriculture, has accepted appointment as Kansas state treasurer in succession to Tom B. Boyd, who faces serious charges in connection with his administration. Dr. Jardine was formerly president of the Kansas State College and was a member of the cabinet of President Coolidge from 1926 until 1929.

IN view of the appointment of Lee A. Strong as chief of the Bureau of Entomology, Avery S. Hoyt, now assistant chief, will become acting chief of the Bureau of Plant Quarantine.

WILBER D. ENGLE, vice-chancellor of the University of Denver, has been named dean of the Graduate School to succeed Dr. D. Shaw Duncan, who has resigned because of ill health. Dr. Engle will continue to serve as dean of the School of Science and Engineering and professor of chemistry.

DR. ANNE YATES, of the St. Elizabeth's Hospital, Washington, D. C., has been appointed instructor in biochemistry in the Duke University School of Medicine and associate biochemist to the Duke Hospital.

DR. S. S. OBENSHAIN, who completed the work for the doctorate degree in soil fertility at Iowa State College a year ago, has recently been appointed to a position at the Virginia Agricultural Experiment Station, where he will have charge of the work of the Soil Survey in Virginia.

DR. A. H. WIEBE, formerly of the U. S. Bureau of Fisheries, has been engaged by the Fish, Game and Oyster Commission of Texas. Dr. Wiebe will make limnological investigations on the lakes and rivers of Texas, as well as supervise the work at the state fish hatcheries.

Nature reports the following appointments in the Colonial Agricultural Service: A. C. Barnes, to be director of agriculture and island chemist, Jamaica; D. L. Blunt, to be director of agriculture, Cyprus; H. B. Stent, to be agricultural chemist, Coffee Experimental Station, Tanganyika.

DR. HENRY D. CHADWICK, of Detroit, took up on October 2 his work as commissioner of the Massachusetts State Department of Public Health, to succeed Dr. George H. Bigelow, who resigned to become director of the Massachusetts General Hospital.

THE following members of the faculty of Columbia University have been appointed to serve as members of the Board of Managers of the New York Botanical Garden pursuant to the provisions of the act recently passed by the Legislature: Drs. Robert A. Harper, Torrey professor emeritus of botany; Sam F. Trelease, professor of botany; Edmund W. Sinnott, professor of botany in Barnard College; Marston Taylor Bogert, professor of organic chemistry.

DR. ALBERT EINSTEIN sailed for New York from Southampton on October 7 to take up his work at the Institute for Advanced Study at Princeton.

DR. HARRY M. MILLER, JR., of the department of zoology at Washington University (St. Louis), who spent last year in Europe as a special representative of the Rockefeller Foundation, has been granted an additional year's leave of absence. Professor Miller has been visiting the principal European countries, studying university programs in the natural sciences and arranging grants, fellowships, research projects and exchanges of students. He succeeded Professor Frank B. Hanson, who returned last year to Washington University and was recently appointed assistant director of the Natural Science Division of the Rockefeller Foundation.

DR. Y. L. KENG, fellow of the Rockefeller Foundation, who has spent the last three years working in the grass herbarium of the U. S. National Herbarium on a manual of the grasses of China, having completed his work and received the degree of Ph.D. from the George Washington University, sailed for Europe on October 5. He will visit the herbaria in London, Paris, Geneva, Berlin and Vienna, to study the collections of Chinese grasses before leaving for China about the end of the year to resume his place on the faculty of the National Central University, Nanking, China.

DR. E. B. STEPHENSON, physicist in the sound division of the Naval Research Laboratory, has returned from a six months expedition on the USS *Eagle 58* to determine certain oceanographic conditions which affect the transmission of sound through sea water. Studies were made in areas adjacent to Panama, San Diego, San Francisco, Honolulu and at San Diego and Panama on the return trip.

THE ABBÉ GEORGES LEMAÎTRE, professor of astrophysics at the University of Louvain, will be visiting professor at the Catholic University of America in Washington, D. C., for the coming year. Abbé Lemaître will lecture on "Astronomical Applications of the Theory of Relativity" and will conduct a seminar for advanced students of physics and mathematics in the Graduate School of that institution. Abbé Lemaître is known for his contributions to the theory of the expanding universe. He spent last year at the California Institute of Technology and the Mt. Wilson Observatory engaged in astronomical study.

THREE German scholars have been appointed visiting professors at Columbia University. They are Paul Tillich, philosophy; Felix Bernstein, mathematics, and Rudolf Schoenheimer, biological chemistry. Professor Tillich was until recently professor at Frankfort. He had previously held professorships at Marburg and Dresden. Professor Bernstein had been professor at Göttingen since 1911. In 1917 he founded and became director of the Institute of Mathematical Statistics at Göttingen. Professor Bernstein visited America in 1925 and again in 1932. Professor Schoenheimer had been head of the department of pathological chemistry at Freiburg and subsequently during 1930 and 1931 he was Douglas Smith fellow in the department of experimental surgery at the University of Chicago. Since February last he has been in this country engaged in research work under the auspices of the Josiah Macy, Jr., Foundation.

DR. JOHN MILLER, formerly resident physician in pediatrics at the University of California Hospital, who has been conducting research on whooping cough at the Staats Seruminstitut in Copenhagen, as a National Research Council fellow, will continue his work under the fellowship at the department of bacteriology at the university. He plans to collaborate with Associate Professor A. P. Krueger.

PROFESSOR G. H. PARKER, director of the Harvard Zoological Laboratories, has been invited to deliver the Somerville lecture at McGill University on November 24. He will speak on "The Cellular Transmission of Substances, Especially Neurohumors."

DR. WILLIAM CROCKER, managing director of the Boyce Thompson Institute for Plant Research, Incorporated, Yonkers, New York, lectured on October 2 before the Rochester Section of the American Chemical Society on "Some Biochemical Researches Being Conducted at the Institute."

DR. W. EDWARDS DEMING, associate physicist in the Bureau of Chemistry and Soils, is giving a set of seventy lectures this fall and winter in the U. S. Department of Agriculture on "The Theory of Errors, Adjustment of Observations and Curve Fitting." The subject will be treated by studying recent developments in mathematical statistics.

DR. VIRGIL JORDAN, president of the National Industrial Conference Board, Inc., New York City, will be the principal speaker at the dinner which will follow the seventh annual open meeting of the Metallurgical Advisory Board to the Carnegie Institute of

Technology to be held in Pittsburgh on October 20. Dr. Jordan's address will be the concluding event in an all-day meeting which will be held at the Carnegie Institute of Technology. At the morning and afternoon sessions reports of researches done in the metallurgical laboratories at the institute will be given.

THE twenty-third annual clinical congress of the American College of Surgeons opened at the Century of Progress, Chicago, on October 8 under the presidency of Dr. J. Bentley Squier, professor of urology at Columbia University.

THE annual meeting of the American Public Health Association was held in Minneapolis from October 9 to 12. Dr. John A. Ferrell, associate director of the International Health Division of the Rockefeller Foundation, is president. He will preside at the first general session and will make an address on "America's Contributions and Problems in Public Health." At the banquet on October 9 as many as possible of the living members of the U. S. Army Yellow Fever Commission who volunteered as subjects in its historic experiments, will be present. Major Walter Reed, chairman of the Army Commission, made the first announcement of his success in transmitting the disease by the mosquito at the meeting of the American Public Health Association at Indianapolis just thirty years ago. The Surgeon General of the U. S. Army, Major General R. U. Patterson, and General Frederick F. Russell, director of the International Health Division of the Rockefeller Foundation, made the principal addresses.

THE one hundredth anniversary of the founding of the Faculty of Medicine of the National University, Mexico City, will be celebrated in October. There will be a week of "Medical Days," October 23–28, during which lectures, clinics and laboratory demonstrations will be given in public and private hospitals. The committee in charge of the centenary celebration has invited the governments of several countries and the principal universities of the world to send representatives and is preparing a program of entertainment.

THE British Institute of Metals, according to *Nature*, held its silver jubilee autumn meeting in Birmingham from September 18 to 21, under the presidency of Sir Henry Fowler. The institute was founded in Birmingham twenty-five years ago. An inaugural lecture on "Twenty-Five Years' Progress in Metallurgical Plant" was given by Mr. W. R. Barclay, vice-president, and a series of fourteen papers dealing with various phases of metallurgical work are to be delivered. A feature of the meeting was the reproduction of the first office of the Institute of Metals. This was housed in the metallurgical department of the University of Birmingham, and was set up by the institute's first and only secretary, Mr. G. Shaw Scott, who, with the president and the chairman of the executive committee, will receive the remaining original members of the institute in the reconstituted office. Here visitors will have an opportunity of inspecting the earliest records of the institute—including the original membership applications and photographs taken during the inaugural meeting in 1908. During Mr. Shaw Scott's period of office as secretary and editor the membership of the institute has increased from 200 to 2,200. Whereas originally the membership was confined almost entirely to Great Britain, it now covers the whole world. The institute removed in 1909 to London, where it now has offices at 36 Victoria Street, Westminster, S.W.1.

A RESOLUTION was adopted at the recent Leicester meeting of the British Association for the Advancement of Science "to request the council to consider by what means the association, within the framework of its constitution, may assist towards a better adjustment between the advance of science and social progress, with a view to further discussion at the Aberdeen meeting."

DISCUSSION

PRONUNCIATION OF BOTANICAL TERMS

THE diverse pronunciation of botanical terms aroused H. A. Gleason[1] in 1932 to publish an article on that subject. He found that some of the causes for diversity may be attributed to the conflict between the properties of classical and modern languages. Rather guardedly he suggested as a remedy six arbitrary rules, the aim of which is to cause the root elements of spoken scientific terms to be heard as distinct, undistorted entities. Except for an apparent minor blemish in that the vowels of some syllables illustrating the application of the rules are not marked according to familiar dictionary usage for syllables ending with consonants, this is an admirable paper and should receive wide circulation. Its proposals should be accepted and practised universally by English-speaking botanists and zoologists.

Although Dr. Gleason dealt with some of the difficulties attending the pronunciation of scientific names derived from personal and other proper names, he did not consider the surgical method I shall now propose for treating commemorative genitives. According to the codes of nomenclature, these names receive the

[1] H. A. Gleason, "The Pronunciation of Botanical Names," *Torreya*, 32: 3, 53–58, 1932.

termination *i* or *ii* when masculine and *ae* or *iae* when feminine. My proposal is that these endings be omitted. Thus, instead of writing *Picea engelmanni, Quercus michauxii* and *Pedicularis furbishiae,* I would write *Picea engelmann, Quercus michaux* and *Pedicularis furbish.* This method has a number of distinct advantages, namely, (1) it eliminates tongue-twisting and ambiguous pronunciation. As matters stand now, *engelmanni* may be pronounced engelmann-ee or engelmann-eye and *michauxii,* michaux-ee-ee or michaux-ee-eye. (2) It honors the commemorated person by giving his name as it actually was or is without distortion. True, there will be no distinction as to sex, but is that necessary in such scientific names? (3) It eliminates a grammatical rule and its subsidiary regulation which says when to use *i* or *ii.* (4) It simplifies spelling. (5) It dispels the misconception of possession implied in the use of the genitive. Possession does not exist in fact in the application of scientific names. I do not object to calling a plant Engelmann spruce or Furbish lousewort, but I am considerably irritated by Engelmann's spruce and Miss Furbish's lousewort. Common sense suggests that while these plants were named for those persons, they do not belong to those persons. In short, such specific terms are functions of the scientific names and not of the persons or places from which they were derived, and the names themselves pertain to the objects named, not to the namer or namee.

The elevation of commemorative genitives to the level of substantives in the nominative without endings would place these specific names on a par with similar substantives derived from mythological or historical characters and exemplified in zoology, as, for example: *Satyrodes eurydice, Pyrameis atalanta, Polygonia faunus, Atrytone pontiac,* and *Poanes massasoit.* The parallel may be extended to include many other names in which the specific name, for one reason or another, is a common noun in the nominative, as *Felis leo* and *Polygonia comma* in zoology and the following in botany: *Brassica napus, Cynodon dactylon, Hicoria pecan, Myrica gale, Prunus cerasus, Quercus ilex, Quercus suber, Salsola kali,* and *Rhus toxicodendron.* In such names as *Crataegus crus-galli* and *Paliurus spina-christi,* which have hyphenated specific names involving phrases, there is justification for the genitive; but the making of such names should be discouraged unless the words be consolidated, as *crusgalli, spinachristi, uvaursi* and *bonanox. Aster novae-angliae* should, in my opinion, be *Aster nova anglia.*

The outcome of a surgical operation may be unfavorable unless important accessory procedures accompany the treatment. Likewise, in this matter of amputating the genitive endings of proper names, serious complications likely to arise from the use of capitals must be anticipated by appropriate measures. Capitalization of some specific names is approved by most botanists, but is discouraged by many others. Zoologists, however, are now almost a unit in opposition to the practise. The botanists hold that specific names are to be capitalized when (1) the name is derived from that of a person or place and (2) the name is the ancient generic name. The omission of capitals in these instances is scored succinctly by Britton and Brown[2] as follows: ". . . Should this custom prevail, much information concerning the history and significance of the specific names would be lost." This argument, it seems to me, can be met easily. (1) The professional botanist who does not recognize the name of Engelmann in *Picea engelmanni* or *Picea engelmann,* no matter what his other qualifications may be, lacks the historical background and perspective of his subject. (2) To all other persons the name *Picea engelmanni* is merely what it is intended to be, namely, a depersonalized label designating a species of tree. (3) The use of the ancient generic name as a specific name does not elevate the total scientific name to greater distinction than it would have if the specific name were some other word; and capitalizing the name adds nothing to its value but really subtracts from its usefulness, because apart from its context it may be confused with a capitalized generic name. (4) The author of a new name is credited by having his name attached thereto; and when he coins new generic and specific names whose derivation and use are not obvious, he owes it to his reader to supply the etymology and all other pertinent information at the time of publication. This should be made mandatory in all codes. Thereafter any one eager to deal with such matters can usually, without much difficulty, discover all the information which Britton and Brown say would be lost by non-capitalization.

The advantages of decapitalization of specific names are so obvious as scarcely to need elaborate mention. (1) Decapitalization gives uniformity of type. In looking down a list of species one does not want to see disfiguring and disconcerting capitals disrupting the sequence. (2) It saves taking routine thought. The simple rule—do not capitalize any specific names—offers the saving short-cut desired by the busy person who cares for the substance, not the superficialities, of things. (3) It gives distinction to specific names as compared with capitalized generic names. Insistence upon the capitalization of specific personal names, while earnest and sincere in

[2] N. L. Britton and Addison Brown, "Illustrated Flora of the Northern United States and Canada," Vol. 1, Introduction, page 11, 1896.

motive, nevertheless seems to me to smack suspiciously of a subtle form of hero or ancestor worship. The botanists should now without hesitation follow the wise leadership of the zoologists in abandoning the capitalization of all specific names. Once this result has been realized and all new specific names derived from common and proper nouns are made substantives in the nominative, chiefly without endings, two forward steps will have been taken toward those much-desired ends, uniformity and simplicity in nomenclature and clearness in pronunciation.

ROLAND W. BROWN

U. S. GEOLOGICAL SURVEY

THE CHEMICAL NATURE OF ENZYMES

NOT very long ago Willstätter[1] declared that enzymes were not proteins and claimed to have obtained some enzymes wholly free from protein. Now Waldschmidt-Leitz,[2] one of Willstätter's pupils, accepting the ideas of Zeile and Hellström[3] and of Kuhn, Hand and Florkin,[4] compares the enzymes catalase and peroxidase with one of our best known proteins, namely hemoglobin. But he is careful to speak of the hematin[5] as the important part of hemoglobin, catalase and peroxidase; the protein part acts only as carrier. If the analogy between hemoglobin and catalase and peroxidase is correct, then hemoglobin is not a true chemical compound, but merely an adsorption complex; and the properties of hemoglobin, except for quantitative differences, are to be attributed not to the molecule of hemoglobin as a whole, but to the hematin side-chain. In catalase, according to Waldschmidt-Leitz, the hematin is the enzyme proper, or active part. But catalase itself is about ten million times more active in decomposing hydrogen peroxide than hematin is[6]; so it appears to me that the protein carrier deserves considerable credit for the activity of catalase. If the carrier acted merely as a protective colloid then hematin suspended in almost any lyophylic colloid should possess high catalase activity; such, however, is not the case.

Willstätter's[7] carrier, or *Träger* theory has been generally accepted, but in my opinion satisfactory evidence in support of this theory has never been offered. One of the defects or virtues of the theory, depending upon one's point of view, is its indefiniteness, which enables it to be interpreted to suit the occasion. At one time the carrier was simply some colloid which could be replaced by another colloid. Now Waldschmidt-Leitz admits that the carrier is responsible for great quantitative differences in enzyme activity. Waldschmidt-Leitz[8] has spoken of the protein of my urease crystals as a "possibly especially suitable carrier," and Willstätter[9] has mentioned the possibility of a "necessary carrier." As far as I am aware the exact nature of the union between the carrier and the enzyme proper, whether purely physical or weakly chemical, has never been precisely stated.

When making an argument it is customary to take notice of evidence both for and against the point in question. However, Waldschmidt-Leitz does not do this. He says, regarding crystalline urease: "Trypsin digestion of the crystalline protein of urease takes place without significant change in urease activity." He makes no mention of our finding that urease is not digested by trypsin[10]; nor does he allude to our researches which show that crystalline urease is rapidly inactivated by pepsin and papain and that the inactivation by pepsin occurs at the same rate as its digestion.[11] Yet another important point, not mentioned in his criticism of crystalline urease, is the finding by Kubowitz and Haas[12] that crystalline urease has the same type of absorption spectrum as the simple proteins and that this absorption spectrum coincides with the destruction spectrum for urease.

Waldschmidt-Leitz says in his paper: "The finding of crystalline protein-enzyme compounds may lead to the concept that enzymes are merely proteins, and thus cause investigators to disregard enzyme specificity which can only be explained by the existence of highly specialized groups." I think there is little danger of this. The enzyme, as I consider it, is in some cases a simple protein, in others a conjugated protein where the properties are to be ascribed to the molecule as a whole. But whether the specific active groups are in the protein part or in the side chain, the enzyme is a protein, as I demonstrated in 1926.[13]

JAMES B. SUMNER

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[1] R. Willstätter, *Berichte*, 59, 1591, 1926; *Naturwiss.*, 15, 585, 1927.
[2] E. Waldschmidt-Leitz, SCIENCE, 78, 189, 1933.
[3] K. Zeile and H. Hellström, *Zeit. Physiol. Chem.*, 192, 171, 1930; K. Zeile, *Zeit. Physiol. Chem.*, 195, 39, 1930.
[4] R. Kuhn, D. B. Hand and M. Florkin, *Zeit. Physiol. Chem.*, 201, 255, 1931.
[5] Waldschmidt-Leitz employs the term "hemin."
[6] K. G. Stern, *Zeit. Physiol. Chem.*, 215, 35, 1933.
[7] R. Willstätter, *Berichte*, 55, 3601, 1922; 59, 1, 1926.
[8] E. Waldschmidt-Leitz and F. Steigerwaldt, *Zeit. Physiol. Chem.*, 195, 260, 1931.
[9] R. Willstätter and M. Rohdewald, *Zeit. Physiol. Chem.*, 204, 181 and especially 186 and 187, 1933.
[10] J. B. Sumner and J. S. Kirk, *Zeit. Physiol. Chem.*, 205, 219, 1932.
[11] J. B. Sumner, J. S. Kirk and S. F. Howell, *Jour. Biol. Chem.*, 98, 543, 1932.
[12] F. Kubowitz and E. Haas, *Biochem. Zeit.*, 257, 337, 1933.
[13] J. B. Sumner, *Jour. Biol. Chem.*, 69, 435, 1926.

ASSORTATIVE MARRIAGE AND INFERTILITY

QUANTITATIVE analyses of marriage selection have established that there is a general tendency in human beings for "the attraction of certain classes of males to certain classes of females" (Pearson).[1] Correlations of physical characters studied with reference to this tendency have yielded an average value of about 0.24 (Willoughby and Pomerat[2]). Schiller[3] has summarized the literature dealing with homogamy in man, with special reference to behavior characteristics.

Materials for the present study were obtained through the kindness of Dr. A. W. Rowe, to whom the writer is deeply indebted. Records of a consecutive series of 107 infertile married couples which were thoroughly studied for diagnostic purposes at the Evans Memorial (Boston, Massachusetts) were used to study the relation between assortative mating and infertility. Since all cases desired children, presumably the contraceptive factor is not involved in this problem. The routine program in this study of sterility has been described by Rowe[4] and a preliminary discussion of the constitutional factors involved was published by Meaker.[5]

Pearson product-moment correlation coefficients of 0.63 ± 0.04 and of 0.40 ± 0.055 were obtained for the height and trunk length, respectively, in these married pairs. These are the highest values which have been thus far reported for homogamy in man. The only other stature correlation recorded to date gave a value of 0.28 ± 0.02 (Pearson and Lee),[6] derived from an English population consisting of 1,079 couples "very largely from the professional classes." It is quite possible that in the groups cited racial factors are involved. These differences as well as additional characters in the infertility group and of fertility characterized by high and low homogamy, respectively, are under investigation. The findings reported, if confirmed, are eugenically important, since they suggest a possible relation between homogamy and fertility.

C. M. POMERAT

CLARK UNIVERSITY

FOSSIL RESIN

IT appears that some of the conifers to-day are repeating their conservational history of ancient times. In New Zealand the copal deposits from ancient Kauri forests, and in the region of the Black Sea the amber deposits, have been interesting for centuries. Now it may be stated definitely that the balsam is doing the same thing. I cut open several gum blisters on a balsam tree that had been dead for six years and found some of them full of liquid gum while in others the resinous matter had hardened into an amber-like consistency. I think this may not be a matter of common knowledge.

CHASE S. OSBORN

REPORTS

THE ONE HUNDRED AND FIFTIETH ANNIVERSARY OF THE HARVARD MEDICAL SCHOOL

CEREMONIES to mark the one hundred and fiftieth anniversary of the founding of the Medical School of Harvard University were held on October 7. The school opened on October 7, 1783, with the induction into office of John Warren as professor of anatomy and surgery and Benjamin Waterhouse as professor of the theory and practise of physic.

On October 6 a program at the Medical School and three of its affiliated hospitals in Boston was arranged by the president and officers of the Medical Alumni Association, open to alumni of the Medical School. During the morning, the alumni inspected the Massachusetts General Hospital, the Boston City Hospital and the Peter Bent Brigham Hospital. In the afternoon they heard a series of talks at the Medical School by members of the faculty, and in the evening an anniversary dinner was held in Vanderbilt Hall.

On October 7 the formal anniversary program was held at Sanders Theater by the president of the university and the dean and faculty of the Medical School. The aim of this program was to repeat in part the exercises held at the college on this day 150 years ago.

The following description of the ceremony is taken from the official program:

> This day, one hundred and fifty years ago, two of the medical professors, viz., Dr. John Warren and Dr. Benjamin Waterhouse, were publicly inducted into office. A ceremony is held to commemorate the occasion.
>
> At about ten-thirty o'clock A. M., the medical alumni and guests with several other gentlemen of the board of overseers and corporation come to the university and, at the steps of Harvard Hall, are received by the president, medical professors and tutors. A little before eleven

[1] K. Pearson and others, "Cooperative Study of Assortative Mating in Man," *Biometrika*, 2, 373 *ff.*, 1902.

[2] R. R. Willoughby, and C. M. Pomerat, "Homogamy in the Toad," *Am. Nat.*, 66, 223, 1932.

[3] B. Schiller, "A Quantitative Analysis of Marriage Selection in a Small Group," *Jour. Soc. Psychol.*, 3, 3, 297–319, 1932.

[4] A. W. Rowe, "Some Constitutional Factors in Human Sterility," *Proc. 2d Int. Cong. Sex. Res.*, 534-544, 1930.

[5] S. R. Meaker, "Constitutional Factors in the Causation of Sterility," *Jour. Am. Med. Assn.*, 92, 1493, 1929.

[6] K. Pearson and A. Lee, "On the Laws of Inheritance in Man," *Biometrika*, 2, 373 *ff.*, 1903.

o'clock, upon the tolling of the bell, all the medical undergraduates assemble in the front of Harvard and form in two ranks in inverted order. As soon as they are formed, the president, the rest of the corporation and the professors and tutors precede the members of the board of overseers, the council of the medical alumni association, the officers of the Massachusetts Medical Society and other gentlemen present down the steps of Harvard from whence they are conducted by the undergraduates to Sanders Theater, who, at the front door, open to the right and left, and stand with their heads uncovered till the governors of the university and the other gentlemen of the procession have passed into the meeting house.

After the company has all entered the exercises begin:

1. The president (James B. Conant) calls upon the chairman of the Board of Preachers (Dean Willard L. Sperry) to open the solemnity with prayer.

2. The president delivers a short introductory oration, in which he makes mention of the medical institution and declares that in the meeting house on October 7th, 1783, with good wishes for their usefulness, Dr. John Warren had been regularly chosen and publicly declared professor of anatomy and surgery, Dr. Benjamin Waterhouse of the theory and practise of physic and Dr. Aaron Dexter of chemistry and materia medica, who had all accepted the trust, the two first of whom were present.

3. The 13th, 14th, 15th and 16th verses of the CXXXIX Psalm according to Tate and Brady's version are sung.

4. The president calls for the inaugural orations of Professors Warren and Waterhouse, which are delivered from the desk in the English language for Dr. Warren by the Herseian professor of anatomy (Dr. J. Lewis Bremer) and for Dr. Waterhouse by the Herseian professor of the theory and practise of physic (Dr. Henry A. Christian).

5. The president begs A. Lawrence Lowell, Esqre, to address the meeting.

6. The 1st, 2nd, 3rd and 4th verses of the CIII Psalm according to Tate and Brady's version are sung.

Immediately after the singing, the company is dismissed and may dine in the Faculty Club.

Inaugural Oration of John Warren

The following is an abstract, in translation of the original inaugural address, delivered by Dr. Warren on his inauguration as professor of anatomy and surgery at Harvard on October 7, 1783. It was read by Dr. J. Lewis Bremer, Hersey professor of anatomy.

At the opening of his address, Dr. Warren, like Dr. Waterhouse, stresses the many new discoveries in the field of science:

> Every one who has a real love for the liberal arts must also take the keenest interest in the study of physics, or the natural sciences, and rejoice in the advances made in these subjects in our present times. Every part of Europe is full of activity in the field of experimental chemistry, so that scarcely a wind blows from that quarter that does not carry with it tidings of new discoveries. In no lesser degree the science of botany lays claim to renown for new advances, especially for the most excellently arranged nomenclature of Linnaeus. The science of natural history also is on the verge of great developments, as evidenced both by the great collections of books on the subject and by the investigations concerning the structure of animals diligently pursued by the French philosophers; from whose industrious labors has been born a new classification, and a division of species according to structure, highly perfected, into orders and suborders. And now the science of comparative anatomy, first fostered by the Greek philosophers, Plato and Aristotle, before they ventured to explore the human fabric, has become rejuvenated through the accomplishments of such renowned scholars as Hume in England, Cuvier and Dumeril in France, Blumenbach and Camper in Germany, so that it has been built anew from its very foundations.

Stating that the natural sciences "already flourish" at Harvard, Dr. Warren describes the facilities now ready at the new Medical School:

> A new College of Medicine, upraised on no high pinnacle, but with a broad foundation under the ample wings of the university, is now made ready for the useful art of healing. A magnificent collection of instruments of natural philosophy, removed from the obscurity which they have formerly endured, now shines resplendent in the ample hall. In addition, many faithful reproductions of the human body are to be seen, which only lack a theater adequate for their proper display. If with all this we might increase her renown for a learning already great, no academy should be more worthy of praise than ours.

Inaugural Oration of Benjamin Waterhouse

The following is an abstract, in translation, of the original inaugural address, delivered by Dr. Waterhouse on his inauguration as professor of the theory and practise of physic at Harvard on October 7, 1783. It was read by Dr. Henry A. Christian, Hersey professor of the theory and practise of physic.

After addressing the governing boards of the college, and mentioning the recent disturbance of the Revolutionary War, Dr. Waterhouse continued:

> When we were oppressed by war and by its accompaniments poverty and death, when the enemy was without and the traitor was within our walls, when our bonds of union were lax and almost dissolved, when hope only was left, the fact that in the midst of such threatening evils we took occasion to cultivate the liberal arts is surely more than could have been expected and easily surpasses every example. And yet during a period of great confusion and during a time when all tranquillity and leisure were absent, colleges and various learned societies were founded in our midst. Among dire calamities there always shone somewhere in this country the hope of reestablishing the arts; and now under Harvard's auspices, a School of Medicine has put forth its head. There can be no doubt that our deeds in this age

will be remembered for a long time. Authors in future will not fail to admire the men of America who, unmoved by the swords or insults of their enemies, devoted their energies to the restoration of letters as well as to the establishment of an independent republic.

Now that the storm is over and we have acquired leisure and liberty, let us remember that a Medical School is the strongest defense against illness, that common ravager of all nations. For it is the function of the medical profession to preserve those who are in health, to strengthen those who are weak, and to restore if possible or at least prolong the lives of the dying.

The address then refers to the various subjects of medicine, described as "anatomy, chemistry, the science of herbs, and the knowledge to be gained from the whole of Nature." The address stresses the modern advances of medicine as follows:

The industry of modern days has discovered many new facts about the composition of the body. Much still is hidden and will probably remain long hidden. None the less who ever wishes to compare the ancient physician with the modern must admit the superiority of the modern, taking into consideration our present-day knowledge of anatomy, chemistry, surgery, botany and physics, remembering the new remedies that have been devised and the old ones discarded.

After discussing the existing fields of medical knowledge, the address strikes another modern note, and points to a new field—the treatment of "mental illness."

What is more human, more worthy of man and Christianity than to help the weak, the diseased and the suffering? It is to be lamented that the field of medicine which treats of mental illness and of cures for the mentally diseased is still so uncultivated and so deserted that it is almost nonexistent. The dignity of the argument commands, the progress of medicine persuades and the love of the human race should compel Harvard University to commence the investigation of means to combat such illness.

The conclusion is as follows:

Sagacious and learned president, generous members of the Corporation and Board of Overseers, I trust that nothing will be nearer to your hearts and dearer to your honor than Harvard College. From its founding, in every wise man's judgment, Harvard has been of extreme usefulness, glory and help to the whole American Republic. May the college, day by day and forever, make signal progress. To you gentlemen, fathers of your country, my friends and benefactors, has been given the privilege of advancing the medical sciences. You deserve great praise for having established a medical institution here.

College of Cambridge, permit me an adopted son to address you as mother. May you ever proceed on your way serenely and like the rising sun diffuse your light even to the extreme recesses of the Republic.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE ULTRACENTRIFUGE

THE need of the ultracentrifuge as a research tool in so many different fields of science perhaps makes a brief description of some of our experiments in this journal worth while. The method used to rotate the centrifuge is a modification of one used by Henriot and Huguenard[1] for obtaining high rotational speeds and is essentially the same as that described in detail by two of us previously.[2] However, certain important variations and improvements in design will be described, as they make for greater ease of construction and less expense.

Fig. 1a shows a cross-section of a typical arrangement. Air from a compressor is admitted to the chamber B through flexible rubber pressure tubing. Air jets from the tubes L′L impinge upon the flutings U of the rotor and start it rotating. Automatically the rotor seeks a position of stable equilibrium and rides upon a cushion of air just above the surface of the stator. The air entering through C from the atmosphere greatly improves stability and provides automatic adjustment for different air pressures, speeds and weights of rotor. The cylindrical air chamber B is mounted on a rubber washer R′R′ (made of sheet rubber packing) which aids in damping vibrations. The support S is mounted on three screws used for leveling. Because of the great danger of explosion by the rotor by the centrifugal forces, the whole apparatus should always be surrounded by a barricade to insure the safety of the observer. Fig. 1b shows the important part of the stator. Although it is very important to get the holes L′L bored properly if maximum speed is to be obtained, yet there is a considerable variety of angles P and Q and sizes of holes that work successfully.[3] For example, the following dimensions are quite satisfactory: TT = 1⅛ inches, $\beta = 92.5°$, $Q = 46°$, $P = 90°$. The nine holes were bored with a No. 63 twist drill. The angle of the rotor $\alpha = 102°$.

The stator may be made of almost any metal that is easily machined, such as brass, soft steel or duralumin. Although not at all necessary, a hardened steel ring TT makes for longer wear. The rotor

[1] *Comptes Rendus*, 180; 1389, 1925; *Jour. de Phys. et Rad.*, 8: 443, 1927.

[2] See Beams, *Rev. Sci. Inst.*, 1: 667, 1930; Beams and Weed, SCIENCE, 74: 44, 1931.

[3] See above references, Girard and Chukri, *Comptes Rendus*, 196: 327, 1933, and Garman, R.S.I. 4, 450, 1933.

should be made of very strong metal, such as good steel, phosphorbronze or duralumin, because the principal factors that limit the rotational speed are the strength of the rotor and velocity of the air. It might be mentioned that the rotor will run smoothly with the apparatus inverted or sidewise, as well as in the position shown in Fig. 1a.

Fig. 2a shows a cross-section of a rotor used to separate a small amount of the lighter portions of a fluid. The chamber A is filled with the substance to be centrifuged and the rotor spun at an approximately constant speed until separation takes place. A few drops of a heavy fluid that does not mix or react with the substance being centrifuged is then

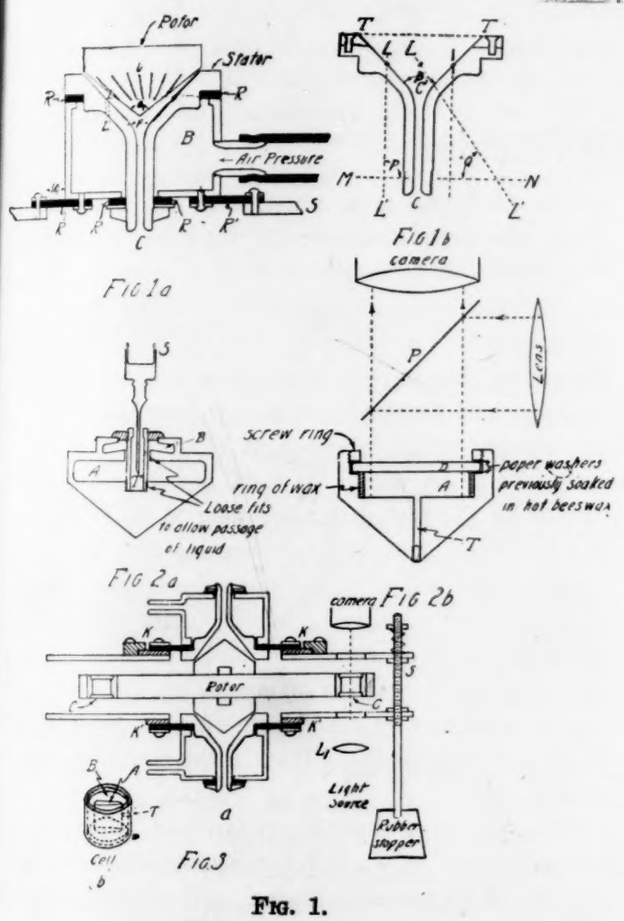

FIG. 1.

"squirted" into the tube T by the syringe S. This immediately enters the chamber A, forcing the lighter fraction into the chamber B, where it is collected after the rotor is stopped. Fig. 2b shows a cross-section of a rotor designed to permit observation of the rate of sedimentation, while the rotor is in motion. Parallel light of a wave-length that is absorbed by either the heavier or lighter (but not both) portions of the substance to be centrifuged is reflected or scattered from the bottom of the chamber A and enters the camera. A photograph is taken first with the rotor turning a few revolutions per second and then at regular intervals with the rotor at high speed. The photographs give a record from which the rate of sedimentation can be found and hence the particle size or micellar weight.[4] Some difficulty was experienced, at first, in getting the glass disk D strong enough to stand the necessary stresses. This was solved by a special heat treatment of the glass. A circular disk cut from ordinary plate glass 3 mm thick was slowly rotated with face vertical in a furnace which was gradually heated until the glass just began to soften. The disk was then quickly removed from the furnace and dropped into compressor oil. After this treatment its strength was increased several times and withstood forces of 2.5×10^5 gravity.[5] The joint between the metal rotor and glass disk was made tight by a ring of special wax made of 25 parts by weight beeswax, 10 lead oxide, 7 rosin, 6 shellac, 3 venice turpentine, 2 paraffin; heated until brown color appears. The wax ring was formed by first heating and then cooling the rotor while it was spun in a lathe. The lower scattering surface of A was made by carefully baking white Duco paint on the steel. This white surface was then covered with a thin film of paraffin. The chamber A was partially filled through the tube T.

Fig. 3a shows another variation in design that we have used to spin comparatively large disk rotors. The rotor is driven by air jets from two stators instead of one, so that more power can be communicated to it. The stators are mounted on three supports S. There are additional adjustments KK′ so that the upper stator can be moved perpendicular to and the lower parallel to the plane of the paper. The other parts are the same as in Fig. 1a. When properly adjusted, the rotor is extremely stable. The process of sedimentation is observed with transmitted light through a cell C with two glass windows. The cell is fastened into the disk-shaped rotor near its periphery and balanced by a dummy cell C′ of exactly the same dimensions and placed diametrically opposite C. With transmitted light the rate of sedimentation may be obtained either by light absorption or index of refraction measurements. The latter is of course best for transparent substances. Fig. 3b shows a top of the cell C. A slit A of 3½ mm average width is machined in the cylindrical cell. The glass disks are then cemented to the surfaces B with hard De Khotinsky. The cell A is filled through the tube T and the cell "squeezed" into a hole bored in the disk-shaped rotor. This type of cell is not very

[4] See Svedberg, "Colloid Chemistry," 2nd ed., Chem. Catalog Company, 1928; or Nichols, "Physics," 1, 254, 1931, for theory.

[5] We are also very grateful to Dr. J. T. Littleton, of the Corning Glass Company, for some very strong glass disks.

satisfactory but will stand up to approximately 10^5 gravity if sufficient care is taken in the construction.

The rotational speeds of the above centrifuges were determined by the stroboscopic method. The maximum rotational speed of course depended upon the diameter of the rotor. The 1⅛ in. all-metal rotor described in Figs. 1 and 2 would rotate up to 3,000 R.P.S. and give centrifugal forces in excess of 4×10^5 gravity. However, the glass disk and seals in Fig. 2b are not as yet practical above 2×10^5 gravity. With a small 1 cm all-metal rotor over 10^6 gravity has been obtained. With the larger 3½ in. rotor shown in Fig. 3a we obtained approximately 10^5 gravity but were apparently limited here by the capacity of our air compressor (we use a garage "Dayton" V-30, but most regular laboratory air compressors should have sufficient capacity). The air pressure of course regulates the speed. We seldom operate above 150 pounds per square inch, 90 pounds per square inch being a convenient working pressure. The temperature of the centrifuge is usually just below room temperature.

In conclusion, we believe that the air-driven type of ultracentrifuge described above offers certain important advantages as follows: First, it is simple and easy to construct; second, the design may be widely varied to suit the need of the experimenter, and still remain extremely stable;[6] third, the cost is very little if air pressure is already available; and fourth, the centrifugal forces developed are as high as any material (as yet tried) of the rotor will safely stand.

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SPECIAL ARTICLES

EXPERIMENTAL MENINGOCOCCAL INFECTION IN MICE

INVESTIGATION of the biology of meningococcus has been retarded by the lack of a satisfactory means of producing experimental infection in laboratory animals. Although guinea-pigs and mice succumb to intraperitoneal inoculation, the dose required of the most virulent strains is very large. Even when a fatal issue has resulted, it is not always possible to recover living organisms from the heart's blood or from the peritoneal cavity itself. Considering the essential toxicity of meningococcus, it seems reasonable to regard such heavy inoculations as overwhelming intoxications rather than true infections. It has been found, in fact, that the minimum lethal dose of meningococci suspended in saline is so close to that of heat-killed organisms that the difference falls within the limits of experimental error. Of particular interest in this connection is the work of Branham and Lillie[1] on experimental meningitis produced in guinea-pigs by intracisternal injection. They report that boiled or filtered suspensions of meningococci produced essentially the same clinical as well as histopathological pictures as did living organisms.

In the course of experiments begun some time ago in the hope of establishing gonococcal infection in some laboratory animal, various menstrua for the organisms were tried out. Since the gonococcus in its natural host gains a foothold in a surface covered by mucous secretion, it was assumed that mucin, the characteristic constituent of mucus, might provide a desirable environment for the initiation of growth under experimental conditions. Of the several preparations tried, the most practicable was found to be mucin prepared commercially from hog's stomach.[2] While this was more satisfactory than other vehicles for the inoculation of gonococci, its value in promoting experimental infection with meningococci was even more striking. It has been possible, in fact, to produce with regularity a fatal infection in mice by the intraperitoneal injection of relatively few organisms. That the mucin is itself non-toxic is demonstrated by the fact that mice seem to suffer no more ill effect from the intraperitoneal injection of 2 cc of mucin than from an equal quantity of salt solution. A report[3] has recently appeared on the enhancement of virulence of pneumococci and hemolytic streptococci for mice by means of mucin, but since this species is naturally susceptible to these organisms, the effect is less pronounced than in the case of meningococci.

The suspension fluid is prepared as follows: hog's gastric mucin is washed for several days in many changes of 70 per cent. alcohol to remove unnecessary ingredients and also to kill the spores of contaminating bacteria. It is then dried between blotting-paper and dissolved in sufficient saline to make a 6 per cent. solution and buffered at pH 7.4 as is ordinary culture media. Solution is facilitated by adding the saline slowly to the mucin as it is being ground vigorously in a mortar. The solution is then tubed and sterilized in an Arnold sterilizer at 100° C. for one hour every

[1] S. E. Branham and R. D. Lillie, *J. Bact.*, 1933, 25, 90.

[6] See Harvey, *Jour. Franklin Inst.*, 214: 1, 1932; or Beams, *Phys. Rev.*, A 39: 858, 1932.

[2] We have used the preparation marketed by The Wilson Laboratories, Chicago.

[3] W. J. Nungester, A. A. Wolf and L. F. Jourdonais, *Proc.* Soc. Exp. Biol. and Med., 1932, 20, 120.

other day for 3 days, and incubated on the intervening days. The precipitate which forms is discarded and only the clear supernatant used for injection.

Mice infected intraperitoneally with appropriate doses of meningococci suspended in 2 cc of mucin usually succumb within 6 to 24 hours. Cultures of the heart's blood have always been positive if made soon after death. The peritoneal exudate contains large numbers of organisms and relatively few leucocytes. Maximum virulence has been attained by using as the inoculum peritoneal exudate, diluted with mucin. Of nine recently isolated strains, one has been found by this method to have a minimum lethal dose of less than 100 organisms, and another of less than 200 organisms. In the case of the more virulent of these two strains, parallel titrations of peritoneal exudate made with saline and mucin showed the minimum lethal dose with the former diluent to be approximately a million times as great as with the latter. Thus far the loss of virulence resulting from cultivation on artificial media has been regained by two or three passages through mice.

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THE FEEDING REACTION OF SEVERED PROBOSCIDES OF DILEPTUS ANSER

Dileptus is a holotrichous ciliate protozoan which possesses at its anterior end a long undulating proboscis, at the posterior end of which there is a mouth. On the oral side of the proboscis trichocysts are situated. The cilia of this region are longer and stronger than those of the rest of the animal.

A finely drawn glass rod was used as a cutting instrument. The animals were isolated from stock cultures and placed into depression slides. Under a binocular dissecting microscope, having a magnification of approximately 40 diameters the glass rod was used to sever the proboscides of these animals from the main body portions. The feeding reactions were observed under a compound microscope.

The proboscides of some of the animals were cut off just anterior to the mouth and the proboscides of others were cut off just posterior to the mouth. Thus two categories of proboscides were obtained: (1) Proboscides possessing a mouth and (2) Proboscides not possessing a mouth. These were separately placed into isolation dishes containing numerous Colpodas in a small amount of hay medium. In both cases the well-known feeding reaction that Visscher[1] has described took place.

[1] J. Paul Visscher, "Feeding Reactions in the Ciliate, Dileptus gigas, with Special Reference to the Functions of Trichocysts," *Biol. Bull.*, Vol. 45, 1923.

A. Reaction of Proboscides Possessing a Mouth

These swam around quite actively; much more so than the main body portions from which they were severed. If, by chance, one came in contact with a Colpoda it immediately extruded trichocysts. Most frequently either of the following reactions took place:

(1) The cell membrane of the Colpoda was broken down at the point of contact with the trichocysts and thus an amorphous Colpoda was produced.

(2) The Colpoda retained its shape but became immobile. The Colpoda was then passed by action of the cilia of the proboscis toward the mouth, which became distended to receive its food. A food vacuole of the type described by Visscher was formed. The ingested food remained within the posterior portion of the proboscis. A plasma membrane probably had formed at the posterior end where the proboscis had been severed from the main body portion. Such a proboscis continued its activities and with each added Colpoda its posterior portion became more and more swollen until the proboscis lost all semblance to the shape that it had when it was first severed. I have observed as many as six food vacuoles in one of these proboscides.

B. Reaction of Proboscides not Possessing a Mouth

These also swam around quite actively and undulated in the manner similar to that when they were on the whole animals. The same reaction to Colpodas took place with these proboscides. The affected Colpoda was passed down to the posterior end where the mouth was formerly located. Then the proboscis rotated on its posterior end around the Colpoda for a time before swimming away. This characteristic feeding reaction as shown by a specialized small part of the total organism is an interesting physiological phenomenon. The proboscis met up with other Colpodas in a short time and repeated the reaction. The Colpoda was always passed to the posterior end (where the mouth was formerly located) and most often the proboscis with its posterior end closely applied to the Colpoda would gyrate around it.

These experiments were done many times and the same results were recorded in each instance.

The posterior portions usually regenerated new proboscides within two hours. The proboscides that were severed in the evening were seen to have regenerated into complete animals which were about one third as large as a normal-sized Dileptus the following morning.

As a result of these experiments it may be seen

that stomatous and astomatous proboscides have the same feeding reactions as normal Dilepti.

The interesting point is that a small specialized portion of the organism is capable of the same complicated response that is characteristic of the total organism.

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SOLID AND HOLLOW STEMMED GRASSES OF THE JORNADA EXPERIMENTAL RANGE

ORTHODOX descriptions of the grass family contain the statement "stems usually (or mostly) hollow." This characterization has been generally accepted as applying to all mature grasses other than the genera grouped under the tribes Andropogoneae and Nazieae, which are usually cited as exceptions.

My own conception of the stem structure of grasses conformed to this description until early in 1927 when certain grasses, not members of either of the excepted tribes, were found to have solid stems. This discovery led to further investigations, the results of which show that a very high percentage of the mature grasses native to the Jornada plains in southern New Mexico have solid internodes.

A subsequent search of the literature and other sources of botanical information has produced meager results regarding the occurrence of the solid stems in grasses. Only two statements were found to be out of the ordinary. Bews[1] states that the solid stem in grasses may be regarded as a primitive characteristic. Vavilov[2] refers to a solid-stemmed variety of *Agropyrum cristatum* Beauv., which he reports is widely distributed over European and Asiatic Russia.

Bews[1] also states that the culms of grasses are usually hollow, but a number of types have solid stems, including the Andropogoneae and many of the Paniceae.

The scant measure of attention given by authors to the stem structure in the descriptions of species indicates that the prevalence of solid stems in the grasses of the semi-desert Southwest is a local condition, which, possibly, has escaped notice.

Investigations relative to the stem structure of the native and introduced grasses of the Jornada plain were started in the late summer of 1927 and carried through each succeeding summer up to and including 1930. Field methods employed consisted of the following procedure: mature stems of the various species were selected and cut transversely at a point about equidistant from the nodes. The cut ends were examined with a hand lens. If there was any doubt regarding the determinations made with the hand lens, a specimen was selected and preserved for microscopic study.

Grasses examined to date number 70 species, representing 30 genera and including members of 8 tribes. Solid-stemmed grasses numbered 52 species, or 74 per cent. of the total number collected, and hollow-stemmed grasses include 18 species, or 26 per cent.

Annual and perennial plants were classified separately. The annuals include 15 species, of which 7, or 47 per cent., were solid-stemmed and 8, or 53 per cent., were hollow-stemmed.

Perennial grasses included 55 species, of which 45, or 82 per cent., were solid-stemmed and 10 species, or 18 per cent., were hollow-stemmed.

Native perennial grasses produce the major part of all the forage on southwestern plains. In the Jornada region the species of 5 genera—Bouteloua, Sporobolus, Aristida, Hilaria and Scleropogon—furnish 85 per cent. or more of the forage derived from grasses. All the species representing these genera are able to withstand grazing to a marked degree during protracted drought. They have the ability to exist on the less favorable situations, as well as on the more favorable ones. Observed representatives of these genera native to this region are without exception solid-stemmed grasses.

The hollow-stemmed perennial grasses furnish very little forage. They are sparsely scattered throughout the region, being restricted to the more favorable sites. Even on these more favorable locations, such as the bottoms of intermittent streams, or on the higher elevations where the precipitation is greater, the hollow-stemmed species generally exist under the protection of some jutting rock or in the shade of some hardy shrub.

R. H. CANFIELD

SOUTHWESTERN FOREST AND RANGE EXPERIMENT STATION

[1] J. W. Bews, "The World's Grasses," Longmans Green and Company, London, New York and Toronto, 1929.

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